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THE GROSS EARNINGS OF 156 RAILWAYS for the month of October, according to statistics collected by the *Financial Chronicle*, are $51,305,105 as compared with $49,392,902 for the corresponding month of 1889, an increase of 3.87 %. This is the smallest increase per cent. for any month of the present year, although the amount of gain is larger than that of August, the next poorest month. Several causes tended to bring about this result, among which the most important are the heavy earnings of the corresponding month of 1889 and the smaller grain and cotton movements of this year. There are 45 of the 156 roads which show decreases, and 17 of these are comprised in the Middle Western group. The Grand Trunk, New York Central & Hudson River, Wabash, Chicago, Rock Island & Pacific and Chicago, Milwaukee & St. Paul exhibit the largest decreases; and the Atchison, Topeka & Santa Fé, Northern Pacific, Missouri, Kansas & Texas, and East Tennessee, Virginia & Georgia show the largest gains.

PLANS FOR AN ELEVATED ROAD were approved at the stockholders' meeting of Nov. 13 of the West End Railway Co., of Boston, Mass. New stock to the amount of $1,500,000 will be issued to meet the cost of this road next year, and $500,000 in the following year.

THE WESTINGHOUSE AIR BRAKE CO. has brought suit against the New York Air Brake Co. for alleged infringement of six patents on air brakes. The New York Air Brake Co. is a reorganization of the Eames Vacuum Brake Co., and the brake which the company is putting on the market is interchangeable with the Westinghouse, and, in many points at least is identical with it.

THE ELECTRIC LOCOMOTIVES used on the South London Railway were built by Messrs. MATHER & PLATT, of Manchester, under a guarantee that the haulage of the trains should not exceed a cost of 7 cents per train mile. As the London horse car is operated at a cost of 10 cents, and the trains on the District Underground Railway cost 19 cents per train mile, this means a marked reduction in the cost of operating the tunnel. Whether the promised result can be actually attained is yet to be proven. Each train carries 100 passengers and consists of an electric locomotive and 3 cars, weighing in all from 30 to 40 tons. The locomotive weighs about 10 tons, and is carried on two axles on a short wheel base. The schedule rate is 15 miles per hour, with trains every 3 minutes, and a possible reduction to 2 minutes at "rush hours." The maximum power of each engine is 100 HP., and they are designed to run up to 25 miles per hour.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a rear collision, Nov. 14, between two sections of an express train on the Pennsylvania R. R., near New Florence, Pa. The first section of the express (made up of Pullman sleepers and day cars) was due at New Florence at 5:46 A. M., but it was 6:37 when the train reached that station. The fog was so dense that the engineer did not notice the red signal in the tower till after he had passed. He then slowed up and went back for his orders, and then pulled ahead slowly. In the meantime the flagman had gone back to signal the second section (made up of baggage, express and mail cars). According to the conductor the second train crashed into the first within 1½ minutes after the flagman departed. The flagman could not have gone far in that time, yet he says he torpedoed the tracks, and that the engineer of the second section saw his signal. The engine of the second section telescoped into the rear sleeper 10 or 12 ft. and then stopped or the loss of life would have been much greater. The wrecked car caught fire, but the passengers were all got out without harm from the flames. The next sleeper was thrown from the track but nobody in it was much hurt. Two persons were killed and 11 injured, some fatally.

A SERIOUS BRIDGE ACCIDENT occurred at Kansas City, Mo., Nov. 17. The middle span of a combination bridge carrying the Kansas City, Wyandotte & Northwestern R. R. across the Kaw River, gave way under a freight train consisting of an engine, tender, five freight cars and a caboose. The whole train went into the river, and with it a number of packing house employés who were riding across to their work in the city. The stove in the caboose (which was on top of the wreck) set fire to all that remained above water. About ten persons were killed and a number injured. A correspondent writes: "It is thought that the locomotive jumped the track, cutting the floor beam in two."—A bridge on the Buffalo, Rochester & Pittsburg R. R. near West Seneca, N. Y., was wrecked by a freight train Nov. 12. Workmen were repairing the bridge, and had it jacked up. A flagman was sent back to flag the freight, but, as there is a down grade there, the engineer could not stop the train, and as the engine struck the bridge it tipped over, and the cars piled on top of it.

A STEAM LIFE-BOAT has been recently tested in England which developed admirable maneuvering powers. Going at full speed, she made with the rudder one-half circle in 35 seconds and a full turn in 50 seconds. The boat was brought from full speed to a dead stop in 32 seconds, and put at full speed again in 4 seconds. The boat is absolutely under the control of the officer on deck. The coal consumption, under forced draught, is about 200 lbs. per hour, and the boat can carry a 30-hour supply.

THE U. S. FISH COMMISSION will shortly send the *Albatross* to explore the deep sea basin in the Pacific Ocean, lying between Panama and the Gallapagos group of islands. Prof. ALEXANDER AGASSIZ is planning the details.

THE U. S. BUREAU OF YARDS AND DOCKS, through its chief, Commodore FARQUHAR, asks for an appropriation of $2,000,000 for the coming year. Of this amount more than $500,000 would be spent in the Brooklyn yard, including $15,000 for new cranes, $25,000 for workshops and $250,000 for quay walls.

THE BRAZOS RIVER IMPROVEMENT, according to the very latest report of Mr. GEORGE Y. WISNER, the chief engineer, shows that the depth on the bar is now 13½ ft., with 25 ft. to 35 ft. through all the jetty work completed previous to the last May rise of the river. The next rise, in February or March, is confidently expected to give a 20-ft. channel over the bar.

THE STEEL BRIDGE being built across the Columbia river at Vancouver, Wash., by the Union Pacific Railway Co., will be 6,181 ft. long, of which 2,286 ft. will be trestle. The bridge proper will be 3,895 ft. long, and will have thirteen spans. It will be double-tracked, with a roadway on top for teams, and will be supported on pneumatic piers. The draw span will give 200 ft. clear waterway on each side, and the span immediately south of the draw span will be 375 ft. long. The whole structure is to be of steel, built 10 ft. above high water and 40 ft. above low water. The foundations will be sunk 80 ft. below low water and will rest upon coarse gravel. The structure is estimated to cost $1,000,000, and will be completed about Jan. 1., 1892.

THE SHORE SHAFT of the new Milwaukee water-works intake tunnel has been completed, its depth being 150 ft. It is reported that more rock is encountered in the tunnel than was expected, the limestone strata beneath which it was supposed the tunnel would be driven proving to be not horizontal, but to rise and fall considerably. An illustrated description of this intake appeared in ENGINEERING NEWS for Oct. 25, p. 306.

THE CHAIN OF ROCKS TUNNEL under the Mississippi River in connection with the new low service supply for the St. Louis, Mo., water-works has been driven to a point beneath the intake tower. The coffer-dam for constructing the tower is in place. Further particulars regarding this tunnel were given in our issue of Aug. 30, p. 196.

THE CLEVELAND LAKE TUNNEL begun in 1888 for a new water-works intake, is now nearly completed, the heading of the shore section having reached the bulkhead of the lake section on Nov. 13. The tunnel was described in brief on p. 262 of the present volume.

THE NICARAGUA CANAL CO., officially says Senor Don J. F. MEDINA, Minister of Public Works of Nicaragua, has more than fulfilled its concession obligations as to the expenditures upon the work. The Government of Nicaragua congratulates the Canal Co. upon its good work and favorable prospects. The sum of $3,000,000 is said to have been already expended, and the company has 10 years in which to construct the canal.

THE RAMAPO WATER SHED is suggested as a source of water supply to Jersey City, as a substitute for the sources under the control of the I. R. BARTLETT syndicate. Gen. EGBERT VIELE, of New York, is said to be at the head of the new scheme. The Jersey City Board of Trade is considering the subject. Companies are said to be organized under the laws of New York and New Jersey, and one of the promotors stated that these would be put under the entire control of the Board of Trade, and they would be ready to issue stock in 20 days and to submit a proposition for a supply of 50,000,000 galls. daily 30 days later.

FOREIGN STREET MAKING PRACTICE is to be studied by our various consuls and reported upon in full to the U. S. Department of State. This order promises some valuable material in this direction, even though this material should come from an untechnical source. If the consuls will tell exactly what they see and give figures and detail of methods, they will furnish more really valuable matter on this head than is to be found in many more laborious treatises coming from engineering sources.

SUBWAYS IN LONDON are in use on the Holborn Viaduct, in Queen Victoria St. and Shaftesbury Ave. on Charing Cross Road, Northumberland Ave. and under the Embankment, along the Thames. Taken as a type, they are built of brick, and are 11½ ft. high and 7 ft. wide. At the bottom is the sewer, entirely covered over and above this are a tramway and the gas and water mains and electric wires, arranged on projecting cast iron brackets. These subways are ventilated by shafts connecting with trapped outlets on the roadway, through hollow lamp-posts and also through flues built in the buildings above. They are lighted by incandescent electric lamps.

A LARGE BLAST FURNACE, known as Isabella Furnace No. 3, was blown in on Nov. 17, at Etna, near Pittsburg, Pa. About 300 tons of heavy steel plates were used in the construction of the furnace. The output, says the Pittsburg papers, will be 200 tons in 24 hours, produced in four castings.

ALL BIDS for the piling and filling of the lake front site of the World's Fair at Chicago were rejected on Oct. 31 by the board of directors. The bids were from $150,000 to $200,000 higher than expected and new bids on modified specifications will be asked.

A New System of Car Heating by Direct Steam.

Of all the objections which have been raised to the continuous heating of cars by steam from the locomotive, none has been of such weight and none has been backed up by so much foundation in fact as the difficulty in regulating the heat. In ENGINEERING NEWS of June 7, 1890, the reason for this inherent difficulty with the direct steam system was fully explained. It arises from the fact that with the direct steam system the radiation from the pipes can only be varied to suit the weather by changing the pressure of the circulating steam; and the variation which this causes in the radiation is only one-half to one-third the variation that is needed to meet the extremes of temperature outside the car.

Probably even those interested in direct steam systems will not deny that the hot water systems as now perfected keep the passengers much more comfortable than the direct steam systems. Yet because the latter are somewhat the cheaper and simpler, railway managers argue that steam heat on the whole is good enough for the public; and a large proportion of the roads which are applying steam heat to their cars are using the direct system. It is true, however, that for short local runs and possibly for roads in the extreme north, the direct steam has some advantages over the hot water system. A car can be heated and cooled more quickly by it, and put in or out of service without stopping to fill or empty hot water pipes.

At any rate, one of the companies which has already on the market a very good system of hot water heating—the Safety Car Heating & Lighting Co.—has determined to enter the field with a direct steam system as well, to meet the demands of those who want the cheapest system. The especial feature of the direct steam system which this company has designed is that the amount of heat radiated is varied to suit the weather by the simple expedient of varying the radiating surface in the car.

The train pipe used is 1¼-in. iron pipe with hose connections. It is run beneath the car floor so that at each end the center of the pipe is 1 ft. to one side of the center line of the car. The hose connection runs diagonally beneath the ends of the cars, and the coupling is at the center.

At a point near one end of the train pipe is a cross *a*, and close to it on each side are the cocks *b*, *b*. All these cocks are kept open except the one behind the cross on the rear car. This is closed to prevent steam escaping at the rear of the train. This arrangement is superior to the plan of placing a cock at the end of the train pipe, as the latter forms a dead end, which soon fills with water and is likely to freeze.

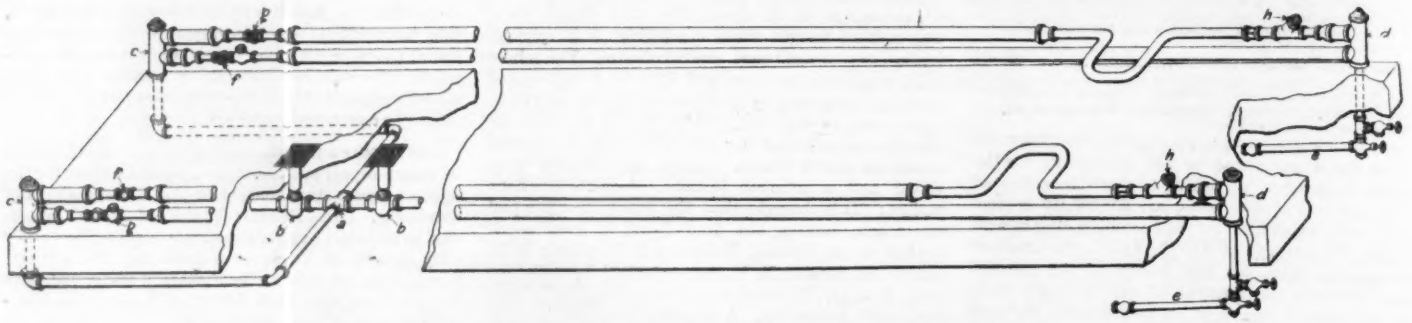
From the cross, 1-in. pipes lead each way and rise near the corners of the car, into the branch tees *c*, *c*. In the four-pipe system the radiating pipes are 2⅝ ins. in diameter, and lead from the branch tee, *c*, back along the sides of the car to the branch tee, *d*, from which the condensed water is drawn off by the trap, *e*.

If desired, in the four-pipe system, steam can be entirely shut off any car by keeping closed the cocks marked *f*, *g*, admitting steam to the radiating pipes. In moderate weather steam is admitted to one or both of the lower pipes on each side by opening the cocks *f*, *f*. In cold weather additional radiating surface is secured by opening one or both of the valves *g*, *g*. In connection with the cocks at *f*, *f*, is a pressure-reducing valve, which reduces the pressure of the steam flowing through it 1¼ lbs. When the valve, *g*, is opened, the swing check valve *h* also opens, and the condensed water flows down into the branch tee *d*, and thence to the trap. It may not be apparent at first glance why the system would not work as well without the pressure-reducing valve; but it is claimed that experiments have shown that the slight resistance of the check valve causes the condensed water to collect in the upper pipe with consequent loss of heating effect. The pressure-reducing valve, however, keeps the pressure in the lower pipe always slightly below that in the upper pipe, thus holding the check valve open and permitting the free flow of water.

The trap is simply a valve having a long copper stem and an iron body. When cooled below 212° the copper stem contracts more than the iron body and opens the valve. The bend in the upper radiating pipe is to permit it to expand and contract without straining the end connections. This is made especially necessary from the fact that one pipe may be cold when the other is full of hot steam.

The six-pipe system has about the same radiating surface as the four-pipe, the radiating pipes being only 1⅝ ins. outside diameter. The lower pipe is always open to the train pipe when steam is turned on. The upper two pipes are connected to the lower pipe and to each other substantially as in the four-pipe system. The amount of acting radiating surface can thus be adjusted very closely, as either two, three, four, five or six pipes may have the steam turned on.

A very good feature of the system is the absence of radiating spurs under the seats, except the single expansion loop. By the use of good-sized pipes plenty of heating surface is obtained when the pipes are merely run along the sides of the car. The company's patents do not cover, of course, the broad principle of regulating the temperature according to the weather by adjusting the amount of radiating surface exposed; and if direct steam heating is to be largely used, it seems probable that many other companies will make use of this principle. The Safety Car Heating & Lighting Co. is entitled to much credit, however, for being the first to apply this principle in a actual work. While the system is in many points inferior to the hot water system, as stated, its cost is over $100 per car less, and this consideration, with its power of adjustment to suit the weather, which no other direct system now on the market possesses, ought to help it to considerable popularity. A number of cars on the Jacksonville Southeastern R. R. in Illinois have been fitted with this system, which is working very satisfactorily.



THE SAFETY CAR HEATING & LIGHTING COMPANY'S DIRECT STEAM SYSTEM OF CAR HEATING.

The Irish Channel Tunnel Project.

This project was presented in a more detailed form at a meeting held on Oct. 17, at Belfast. Mr. BARTON, the Engineer, explained his preliminary plans. The shortest line between Ireland and Scotland was from Tor Head to the Mull of Cantyre, a distance of 13 miles, but the water there was 462 ft. deep, and the site unsuitable. Mr. BARTON proposed to cross between Island Magee and Wigtonshire, with a tunnel about 33 miles long, with 500 ft. of water overhead. The proposed line would leave the Northern Counties Ry. at a point near Whitehead, and pass out under the headland known as the Gobbins; enter Wigtonshire outside of Loch Ryan, at Portobello, and passing under Wiersbon Hill, connect at Stranraer with an existing line of railway.

The heaviest gradient proposed is 1 in 75. In the Mt. Cenis, St. Gothard and Arleburg tunnels the average is 1 in 40; the Mersey tunnel is still steeper, while the Severn has a flatter gradient of 1 in 90. No fears are entertained of trouble from water entering the tunnel; and in this view Mr. BARTON is supported by Sir JOHN HAWKSHAW, Sir DOUGLAS FOX, Sir BENJAMIN BAKER and other eminent engineers. The proposed tunnel would have 150 ft. of rock between the roof and the bed of the sea. The rock is only 30 ft. thick above the Mersey tunnel, and 40 ft. in the Severn.

As to cost, it is estimated that this would not be more than in long tunnels through mountains. Judging from past experience the cost here is put at $500 per lin. yd. The shafts, pumping plant, additional railways, etc., are estimated at $3,305,000, and the total estimate, with 10% added for contingencies, is put at $40,000,000.

The time of construction is estimated at 10 to 12 years. Mr. J. T. BARTON, C. E., explained that a series of large ventilating fans placed at the pumping stations at each end, about 24 miles from each other, could be made to draw out all foul air and supply pure air in a current moving at the rate of 2 miles per hour.

Mr. Hiram S. Maxim on Flying Machines.

In a late letter to the *New York Times*, Mr. HIRAM S. MAXIM corroborates the report that he is engaged in an attempt to solve the problem of flying, with the purpose of finding some type of machine that can be propelled through the air and would be useful for military purposes. As yet, he says, it is only an experiment; but the experiments are so conducted that he is hopeful of final success.

He has rented large grounds in England, erected a building, and has employed two eminent American mechanics to assist him, Messrs. HENRY A. HOUSE and HENRY A. HOUSE, Jr. These experiments are being conducted with the view of finding out exactly what the supporting power of a plane is when driven through the air at a slight angle from the horizontal. For this purpose he constructed a very elaborate apparatus, provided with a great number of instruments, and arranged in such a manner that he can ascertain accurately the efficiency of a screw working in air, the amount of power required to drive a screw, the amount of push developed by a screw, the amount of slip, and also the power required for propelling planes through the air placed at different angles, as well as to ascertain the friction and all other phenomena connected with the subject. He has been experimenting with motors, and has succeeded in making them so that they will develop one horse power for every 6 lbs. His experiments show that as much as 133 lbs. may be sustained in the air by the expenditure of one horse power.

He has found in his experiments that it is necessary to have a speed of at least 30 miles per hour—that 50 miles is still more favorable, and that 100 miles would seem to be attainable. Everything seems to be in favor of high speed.

Mr. MAXIM will publish the result of these experiments. And as he is probably the only man who has thoroughly tested the phenomena of flying, with no stint of money and with delicate and accurate apparatus, his experiments will be most interesting and valuable in this connection. He says he may not himself succeed, but is convinced that in time some one will make a machine of this kind; and he is also convinced that the discoverer will be an American.

A History of the New York Water Supply, and Recent Explorations for New Reservoirs.

BY E. P. ROBERTS, ASST. ENG., AQUEDUCT COMMISSION.

(WITH INSET.)

The importance of this question should commend it to the interest of every taxpayer and resident of this city, as well as to the engineering fraternity throughout the United States.

Much has been written in regard to it; but through a lack of comprehension, or with a view to setting forth the greater advantages of one or another of the various methods advocated, no absolutely impartial treatment of the subject has yet appeared.

A general statement of the adaptability of the Croton watershed to the requirements of the city; the extent to which it has been devoted to that purpose and an outline of the manner in which it has been proposed to still further utilize it, should suffice to convey a fair idea of the magnitude of the enterprise.

A detailed account of the extent to which the subject has been investigated during the past six years should at least assure the general public that whatever may be the decision of the present Aqueduct Commission it will not be a hasty conclusion based upon insufficient data; and to the professional man it should serve as a reliable basis for the study of similar questions constantly arising in connection with the rapid growth and development of our larger cities—especially in the West.

It was decided in 1835 to look to the Croton watershed as the main source of supply for New York City. The construction of the Croton aqueduct, of the Croton dam and the introduction of water into the city was duly celebrated on the 14th of October, 1842, at which time the population was about 375,000.

The question of an increase in the supply was again forced, and in 1857 the Croton Aqueduct Board caused a survey of the Croton watershed to be inaugurated with a view to ascertaining its area, as well as its possibilities for the interception and impounding of waters upon its main and affluent streams. This survey was completed in November, 1858, and before Jan. 1, 1860, the maps of the entire basin, including 16 reservoir sites with estimates of their capacity and cost, were prepared. The area of the watershed above Croton Dam was estimated at 352 square miles. The minimum daily flow of the Croton River was placed at 33,804,000 galls.

Between 1860 and 1862 the subject was not actively brought forward; but in the latter year the Board seriously considered the advisability of constructing storage reservoirs above Croton Dam.

Nothing came of the discussion, however, nor was the following year more fruitful in action than its predecessor. The daily consumption of the city in 1864 was 54,000,000 galls., while the flow of the river during the summer months was but 32,500,000 galls. From June 27 to Aug. 18—52 days—no water flowed over the dam; and on Aug. 3 the level of the water in the lake was 4½ ft. below the weir lip. Careful records of the rainfall had been kept for a number of years, from which it was estimated that a daily average of 338,832,128 galls. of water went to waste over Croton Dam.

This enormous volume of water running to waste during the seasons of flood, contrasted with the meagre supply obtainable during the season when its need was most keenly felt, so aroused public sentiment to the necessity of storing a portion of the surplus, that the Legislature authorized the construction of a storage reservoir. Many of the different sites had been carefully re-examined, and in 1865 negotiations for the acquisition of land were commenced. In 1866 the construction of the Boyds Corners Reservoir was begun. The dam was located on the west branch of the Croton, 24 miles above Croton Dam and 71 miles from the City Hall. The height of the dam was 75 ft.; its elevation above mean high tide at High Bridge was 600 ft., and above the top of the water level of the receiving reservoir at High Bridge 485 ft. The cost of the structure was estimated at $201,000. The area of the basin flooded was about 300 acres, and its estimated storage capacity was 3,000 million gallons. This work was completed in 1872.

At a meeting of the Aqueduct Board on Jan. 3, 1870, it was stated that after Aug. 1 of the preceding year the Croton River supplied but 31,000,000 galls. per day, but that on Oct. 4 a rain storm increased the flow to 60,000,000. The reservoirs at Croton Dam and in the city had a combined capacity of but 1,420,000. The population was estimated at 1,000,000. Assuming the per capita consumption at the very low estimate of 50 galls. per day, the entire storage would have been consumed in 28 days; or if used to supplement the supply of 31,000,000 furnished by the Croton River, it would have been exhausted in 75 days and the city placed on short allowance in the event of a protracted drought. In view of these facts and the further fact that four years had elapsed since the Boyds Corners Dam had been placed under contract, it is not surprising that the Aqueduct Board was abolished and the conduct of its affairs transferred to the Department of Public Works. The position of chief engineer was tendered to Mr. EDWARD H. TRACY, who accepted it on the condition that an appropriation of $1,000,000 should be guaranteed toward the construction of a second aqueduct, which was to connect Croton Lake with a reservoir at Jerome Park.

The downfall of the Tweed dynasty caused the abandonment of this enterprise. It was during the administration of Mr. TRACY that the Boyds Corners Reservoir was completed in 1872, and that the Middle Branch Reservoir was placed under construction in 1873. This reservoir has an estimated storage capacity of 4,000,000,000 galls., and floods an area of about 400 acres. The cost of the land and the construction of the dam amounted to some $672,000. The dam is of earth with a masonry core, whose foundation is in bed rock. The extreme height of the dam is 82 ft., and its length is 972 ft. The overflow is through a channel cut in the rock, and the water is drawn off by means of a by-pass driven through the rock, and around the end of the dam.

Mr. JNO. C. CAMPBELL was appointed Chief Engineer in 1875, to fill the vacancy created by Mr. TRACY'S death. In January of the following year he reported the results of surveys which contemplated the construction of a dam at the head of Croton Lake and just below the mouth of the Muscoot River and an aqueduct connecting this reservoir with one at or near Jerome Park. The storage contemplated was 1,800,000,000 galls.; the capacity of the aqueduct 150,000,000 galls., and its length about 36 miles. The capacity of the reservoir at Jerome Park was to be 600,000,000 galls., stored at an elevation of 42 ft. above the reservoirs in Central Park. From Jerome Park the water was to be conveyed to the city in cast iron pipes. Nothing came of this enterprise but its report, and in the interem between its inception and the year 1878 the Middle Branch Reservoir was completed. A report bearing date Aug. 12, 1879, showed the existing storage—artificial and natural—in the Croton basin to be as follows:

Boyds Corners Reservoir	Artificial	2,727,000,000	galls.
Middle Branch " "	"	4,004,000,000	"
Lake Mahopac	Natural	375,000,000	"
Lake Kirk	"	565,000,000	"
Lake Gleneida	"	165,000,000	"
Lake Gilead	"	380,000,000	"
Lake Waccabuc	"	200,000,000	"
Lake Tonetta	"	50,000,000	"
Barrett's Pond	"	170,000,000	"
China "	"	105,000,000	"
White "	"	100,000,000	"
Pine "	"	75,000,000	"
Long "	"	60,000,000	"
Peach "	"	230,000,000	"
Cross "	"	110,000,000	"
Haines "	"	25,000,000	"
Total		9,541,000,000	

These natural lakes and ponds were made available by lowering their outlets and drawing upon their storage as occasion required.

Owing to some trouble regarding the appointment of Mr. CAMPBELL as Chief Engineer, Mr. GEO. W. BIRDSELL filled that position from 1878 until 1880, when Mr. CAMPBELL resumed his position, which he held until the appointment of his successor, Mr. ISAAC NEWTON, on March 15, 1881.

We are now brought to the discussion of the so-called Quaker Bridge Dam project. On Jan. 30, 1882, ISAAC NEWTON, Chief Engineer of the Department of Public Works, reported to HON. HUBERT O. THOMPSON, Commissioner of Public Works, the results of his investigation of this subject. His report is so thorough and comprehensive that it merits reproduction in full. A summary of its salient points, however, is all that the scope of this paper will permit.

He begins by recognising the value of the data gathered by his predecessors in the nature of reliable information and valuable suggestions. He also considers the various sources other than the Croton, which had been suggested, namely, the Passaic, the Housatonic, the Hudson and the Hackensack Rivers; Lakes George, Erie, Ontario and Champlain, and also the streams in Rockland and Orange counties. The use of wells and salt water to be raised into reservoirs by pumps for auxiliary supply was likewise considered. It may be appropriately stated here that the use of salt water for extinguishing fires had been condemned by the fire underwriters on the ground of its destroying as much merchandise as the flames themselves; by the Chief of the Fire Department because of its corrosive tendencies, and by the Board of Health its use for street sprinkling had been prohibited on sanitary grounds. Mr. NEWTON states that his investigations satisfied him that the Croton River was "by far the most available and the most economic source of supply," and that he had "endeavored to determine the best plan for storing and conveying the water of this river to the city."

He concluded that storage reservoirs would ultimately be required of sufficient capacity to hold all of the waters of the Croton during dry seasons and that in time it would be necessary "*to carry over a portion of the surplus of wet years to supply the deficiency of dry ones.*" He further says: "The nearer the storage reservoirs to the entrance of the aqueduct, if they are of sufficient capacity, the greater will be the quantity of water that can be gathered from the entire basin, and the more rapidly will the reservoirs fill again after being drawn down.

"The time required to fill the existing reservoirs after they have been drawn down is a warning on this point which should be heeded. All the water which falls on that part of the basin situated below the several storage dam sites, shown on the maps of 1857 and 1858, above what is necessary to supply the aqueduct, will run into the Hudson River over the waste-weir of the aqueduct dam, unless storage is provided at that point; so, without a reservoir at that locality, it will be impossible to secure storage in dry years. Hence, storage located at the entrance of the aqueduct is in the most advantageous position."

After discussing the capacity, dimensions, nature and route of the proposed aqueduct Mr. NEWTON returns to the subject of the location of the new aqueduct dam. He considers three sites: 1st above the present dam; 2d at or in the immediate vicinity of the present dam; 3d considerably below the present dam so as to embrace a drainage area which does not now supply the city. The site considered under the third head is the celebrated Quaker Bridge site. "The geological characteristics of the valley and the sinking of test pits led to making surveys for a dam at this place." Over 100 test pits were sunk and two diamond drills were used to explore the bed of the river. The flow line of the Quaker Bridge reservoir, 78 miles, was located and 21¾ miles of cross section lines had been run. This topographical work was accomplished under the immediate direction of Col. JOHN MECHAN, formally of the U. S. Coast Survey. The proposed dam was to have rested upon a foundation excavated in bed rock. Its extreme height, from elevation + 210 to — 65, would be 275 ft. Its width at the crest 18 ft. and at the base 216 ft. The reservoir, or lake, created by it would have a surface elevation of 200 and an extreme flood line at elevation, 206. Its area would have been 3,635 acres and its available storage capacity above elevation 140, was estimated at 32,000,000,000 galls. Reference to the map showing the Croton watershed and the line of the old and new aqueducts will convey a better idea of the structure and its basin.

Mr. NEWTON argued that the 9,000 million galls. already stored; the 32,000 million claimed for the Quaker Bridge reservoir and the 5,000 million to be secured by the construction of the East Branch Reservoir, at that time contemplated—making a total of 46,000 million galls.—would suffice to keep up a daily supply of 200,000,000 galls. for nearly 230 days without the natural flow of the Croton. In contrasting the advantages of such a reservoir with a series of smaller reservoirs in the upper basin Mr. NEWTON advances about all the arguments that have been made by later advocates of the project. He states that the reservoirs in Putnam county would flood its most fertile valleys, while the char-

acter of the land in the lower reservoir would be mainly sterile and of a rocky structure. It would add about 23 square miles to the area of the watershed and thereby insure an increase in the daily supply of 15 or 20 million galls. "It is at the lowest end of the drainage of the Croton and would collect waters more rapidly and completely than other plans." "It would afford a settling basin of the grandest proportions; the loss would be much less from evaporation and other sources on account of greater average depth. *It would avoid conveying the water through miles of rivers, brooks, and in many cases swamps, before it reaches the aqueduct, while in very cold weather the supply from such sources might be wholly cut off by frost, as was the case (with the water from the storage reservoirs) in the winter of* 1880-81."

Then follows a table showing the area, capacity, drainage are a, etc.,of the various reservoir sites surveyed in 1857-58, namely from A to O inclusive. In regard to this table his report says: "The total drainage area of all these reservoirs foots up 480.30 square miles, while the entire area of the Croton basin is 338.82 square miles; this is because the computed drainage of some of the reservoirs overlaps that of others, which shows that the Croton Aqueduct Board did not contemplate that all of these sites could be made available as reservoirs to the extent indicated by this table. The drainage of some of them is so small that in a dry year they probably would not fill. . . . An inspection of the map shows that if all of these reservoirs were built they would not receive the drainage of over 200 sq. miles because they do not furnish storage for the waters of large areas for which sites for reservoirs have not been found." Mr. NEWTON again emphasizes his statement that without a dam in the lower basin the requisite amount of water could not be stored.

In the matter of diverting the waters of the Housatonic into the Croton watershed he says surveys were made in 1879 for conveying this water to the Croton. The plan "was mainly an open canal with a sectional area of 80 sq. ft., and an inclination of 1 ft. to the mile, the calculated capacity being 100,000,000 galls. daily. The comparison of this plan of obtaining water for the new aqueduct with that of storage has been carefully studied in all its bearings. The Housatonic is in Massachusetts and Connecticut, out of the authority of this State, which could, therefore, exercise no control over it to prevent pollution, or enforce any regulations. The water would have to traverse about 80 miles, with exposed surface, before reaching the aqueduct, and in very cold weather there would be great danger of the supply being cut off or greatly diminished when the demand would be greatest." The damage for mill rights and other vested interests were considered serious drawbacks, and likely to greatly enhance the estimated cost. Furthermore, as the records of the flow of water in Croton River in August, 1878, amounted to but 123,000,000 galls.; in December, 1880, to 33,000,000 and subsequently to only about 10,000,000; it was assumed that the Housatonic would in all probability be subject to similar fluctuations; and as its available watershed was but double that of the Croton, it could not be relied upon for a supply exceeding 20,000,000 daily. The report, so far as it bears upon the question of storage, concludes with a table showing the requisite supply necessary to furnish the two aqueducts with 300,000,000 galls. daily, supposing a year as dry as that of 1880, during the months of May to December inclusive, the amount being 54,787,500,000 galls.

The existing storage of 9,000,000,000, plus the 32,000 million furnished by the Quaker Bridge Reservoir and the 5,000 million from Reservoir I to be built on the east branch of the Croton, would furnish the required amount—35,000 million—less 9,000 million, which deficiency could be made good as occasion required. The remainder of Mr. NEWTON'S report is devoted to the "Head of the new supply in New York City;" "The Aqueduct;" "The time required to complete the proposed work," and a statement of the comparative cost of the three plans mentioned in the report.

In conclusion he expresses his indebtedness to Mr. E. S. CHESBROUGH, Consulting Engineer; to Mr. B. S. CHURCH, Resident Engineer, and to Col. JOHN MECHAN. To Col. J. W. ADAMS "for his assistance in making up the estimates, as well as details of plans of aqueduct on which they were based." An appendix gives the opinions of JOHN B. JERVIS, Esq., Constructor of the Croton Aqueduct; of JAMES B. FRANCIS, Esq., President of the Am. Soc. Civil Engrs., and of ROBERT K. MARTIN, Esq., Chief Engr. (new) Baltimore Water Supply. All of these gentlemen give the enterprise as set forth in Mr. NEWTON'S report their unqualified approval in all of its detail.

The Commissioner of Public Works, Hon. HUBERT O. THOMPSON, recommended the construction of the Quaker Bridge Dam and the aqueduct, in accordance with the report of Mr. NEWTON, on the 23d of February, 1882. Mainly through Mr. THOMPSON'S effort and instrumentality the State Senate on Jan. 9, 1883, passed a resolution requesting the Mayor of the City of New York to select and appoint five citizens of the said city to unite with him in investigating the plan as approved and reported by the Commissioner of Public Works and to report on its practicability, probable cost and the time required for its execution "and such other views and recommendations as they may deem proper." In accordance with the resolution the Mayor, Hon. FRANKLIN EDSON, appointed Hon. ORLANDO B. POTTER, JNO. T. AGNEW, WM. DOWD, AMOS F. ENO, and HUGH N. CAMP. This commission held 33 meetings and consulted with a number of eminent engineers and citizens.

Their conclusion was that the Croton watershed was the best source of supply; that the present Croton Aqueduct could not be relied upon for conveying more than 98,000,000 galls. daily to the city; that a new aqueduct should be built immediately; that it should be of sufficient size to carry all the available water of the Croton watershed, and, in conjunction with the old aqueduct, all of the water that might be conveyed from other sources into the Croton basin. Also that the aqueduct should be a tunnel driven through rock wherever practicable.

They agreed unanimously that the dam at the Quaker Bridge "is practicable; provided it be built on solid rock with a width at the bottom quite equal to its height," but were "divided in opinion as to whether the Quaker Bridge Dam should be built, or separate dams for storing water in the Croton basin." They recommended the appointment of an impartial commission, to whom should be entrusted the construction of the work and the decision of all questions bearing upon an increase of the water supply. Their report was transmitted to the Senate March 7, 1883, whereupon that body passed "An act to provide new reservoirs, dams and a new aqueduct, with the appurtenances thereto, for the purpose of supplying the city of New York with an increased supply of pure and wholesome water."

An Aqueduct Commission was appointed consisting of the Mayor, Comptroller, Commissioner of Public Works of the City of New York, and JAMES C. SPENCER, GEO. W. LANE and WILLIAM DOWD.

This commission appointed Mr. BENJ. S. CHURCH Chief Engineer on Aug. 15, 1883, and later Mr. Jos. P. DAVIS Consulting Engineer, Mr. ALPHONSO FTELEY Principal Assistant and Executive Engineer, and Mr. HENRY S. CRAVEN Constructing Engineer. Final plans and the route of the new aqueduct were adopted in the spring of 1884 and submitted at the public hearing required by law. After sundry modifications in the detail plans the contract for their construction was awarded: Sections A and B to HEMAN CLARK; sections 6, 7 and 8 to the firm of O'Brien & Clark; and sections 2, 3, 4 and 5 to Brown, Howard & Co.

The length of the aqueduct is as follows:

	Miles.
Tunnel and open cuts—Croton Dam to Harlem River	28.25
Tunnel, north shore of HarlemRiver to gate house at 125th St	2.50
	30.75
Pipe line from 125 St	2.38
Total length	33.13

To return to the question of storage. On Sept. 8, 1883, the Commissioner of Public Works submitted a plan for a dam and reservoir known as the "Quaker Bridge Dam," and on Sept. 12 the public hearings were commenced. At these hearings a supplementary report was submitted, recommending the construction of the Muscoot Dam as subsidiary to the Quaker Bridge structure. This recommendation came from Mr. CHURCH. The purpose of the Muscoot Dam was to insure a constant depth of water over a considerable area in the upper portion of the Quaker Bridge Reservoir, which otherwise would be exposed in drawing down the storage; such exposure was thought to be detrimental to the health of the neighborhood.

On Nov. 4, 1885, the question was again opened, and the subject was under discussion until Jan. 27, 1886, when the deliberations were finally closed, save in regard to such as should be submitted in writing.

During this time it was decided to construct reservoirs I and H on the east branch of the Croton familiarly known as Sodom Dam. The system consists of a masonry dam thrown across the east branch of the Croton, an earth dam, with masonry core, across Bog Brook, and a tunnel some 6,000 ft. in length connecting the two reservoirs. The estimated storage is about 9,000,000,000.

The Department of Public Works had increased the storage some 2,800,000,000 galls. by the construction of two reservoirs on the Bronx River watershed. Water was first drawn therefrom in 1884. This increased the daily supply from 100,000,000 to 115,000,000 galls.

The opposition to the Quaker Bridge Dam project was headed mainly by Hon. ORLANDO B. POTTER, who was ably and earnestly supported by WM. H. WEBB, Esq. Their position is fully set forth in the report of a "Committee of Twenty-one," consisting of members of the Union League Club. This committee submitted a pamphlet to the Aqueduct Commission during the public hearings of January and April, 1886. Their argument claimed that 78,000 million galls. could be stored from the 174 sq. miles of drainage area of the four branches of the Croton—the East, West, and Middle branches, and the Muscoot River. For this estimate the highest rainfall at Boyds Corners Reservoir is taken as a basis on the ground that rainfall lower down is greater. Fifty-six per cent. of the rainfall is assumed as the average that flowed in to the streams for 13 years. The length of time necessary to build the Quaker Bridge Dam, as compared with that in which smaller reservoirs could be constructed, is the first argument against it. Another advantage claimed for a series of smaller reservoirs some miles above, is that the waters from them would be purer when first impounded; would have to flow from 5 to 20 miles before reaching the mouth of the aqueduct; "and so, though dead water at the start from the reservoir, would, before entering the aqueduct, become living water, thoroughly aerated and healthful, and agreeable to drink; while if it was taken from one great Quaker Bridge Reservoir directly into the aqueduct, it would be dead water, not aerated, and would in that state enter our homes." The committee further recommended the continuance of the plan of building, as required, reservoirs in the upper basin, and leaving to future generations the construction of the Quaker Bridge Dam and the burden of its cost.

It also recommended the immediate construction of the East branch system of reservoirs, as a means of securing an increased supply of water coincident with the completion of the aqueduct. In connection with a reservoir formed by a dam at Muscoot Mountain—whether such a reservoir was intended to furnish available storage, or to serve as a feature of the Quaker Bridge system—the committee very wisely suggested "that the depth to which this reservoir ought to be excavated throughout its whole area and cleared of vegetable deposits so as to preserve for the city only pure and wholesome water should be carefully ascertained together with the probable cost of such excavation." The possible destruction of the Quaker Bridge Dam by an enemy, and the probable loss of Croton Dam in the out-pouring flood, is also cited. Further it recommends the appointment of a commission of three engineers, as experts, who shall be entirely disinterested to pass judgment upon the practicability, safety, and cost of the proposed Quaker Bridge Dam. A letter from SAMUEL MCELROY, Civil Engineer, accompanies their report, in which he condemns the plans for the Quaker Bridge Dam as crude and defective; and the specifications for rubble masonry as "an audacious violation of usual construction for walls of far less strain." Mr. MCELROY is also very sweeping in his condemnation of the views of Col. ADAMS and Mr. CHURCH on the subject of fermentation of the waters impounded in so large a reservoir.

(TO BE CONTINUED.)

The St. Clair Tunnel.

III.

(Preceding articles published Oct. 4 and Nov. 8.)

ADDITIONAL NOTES ON THE SHIELD DESIGNS.

In the drawings and description of the shield published Nov. 8, reference was made to the 2-in. square rubber packing strip at the rear of the shield, designed to prevent water and clay or quicksand from percolating into the shield from the rear. Very early in the work, however, this rubber packing strip had to be abandoned. The friction upon it was so great that it would roll out from the groove in which it was placed, and all efforts to hold it there by tightening the set screws seen in Fig. *a* of the inset of Nov. 8, were fruitless.

There was substituted for it, therefore, a steel ring of the same size. This worked perfectly, and there was never any trouble from clay or water working in between it and the cast-iron lining.

The water-tight doors in the bulkhead of the shield slid in grooves in the door frame and were suspended by chains from the top, shutting by their own weight when the chain was released. The criticism may be made that there was no provision by which the doors could be forced shut from the rear of the shield, and that in case an inrush of water or quicksand had necessitated closing the doors, they would probably have been stuck by the pressure of the current against them before reaching the bottom. In that case, as the door slid on the front of the bulkhead and its outside was a smooth plate, offering no hold to a crowbar, there might have been much difficulty in prying the door down to its place.

The provision of a hydraulic cylinder or a screw gear for forcing home a door, intended for use only in case of an accident against which every precaution was taken, might have been an unwise expenditure; but the door might easily have been so made that it could have been quickly pried down with a crowbar if the necessity had arisen.

The reply to this criticism is that ample precautions were taken against any sudden inrush of water. Borings were made all the time as the shield advanced, at least 8 ft. ahead of the excavation and all over the working face. If a vein of water or flowing quicksand had been struck by the auger, the quantity which could escape through the auger hole would have been so small that the workmen would have had plenty of time to escape and close the door. This point was carefully considered by Chief Engineer HOBSON and his co-workers, and it was decided that the provisions made for closing the door were sufficient.

[Just what would have been done after closing the doors, in case that extreme measure had become necessary, is a problem which the engineers at St. Clair fortunately did not have to solve. It would probably have been attempted to run up the compressed air pressure to a point at which the material in front of the shield would stand, provided this had not been too high for the workmen in the compressed air chamber to endure. The bulkhead doors could have then been opened and the work proceeded with as before.

We described in the preceding article, the manner in which the shields were rolled down the slope of the excavation to the point where the tunnel was to begin. It may have occurred to some readers that unless the work were carefully planned, the shield was as likely to arrive at the bottom with the bulkhead doors on top as at the bottom. This matter, however, was looked after at the outset. The distance the shield would have to roll to reach the bottom was determined; and, knowing its diameter, it was then an easy thing to build the shield at such a point that it would be right side up when rolled into position, or so nearly so that a slight slipping on the skidways would bring it right.

THE COMPRESSED AIR WORK.

From the place where the shields were started to the point where the tunnel passed under the bank of the river was 1,716 ft. on the American side and 1,994 ft. on the Canadian side. When the shields reached these points it was deemed safer to begin the use of compressed air. Solid brick bulkheads were built, therefore, in the completed portion of the tunnel just back of the shields. Each bulkhead was 8 ft. in length, built of first quality brick, laid in cement mortar. Into each bulkhead were built two air locks, 17 ft. long and 6 ft. in diameter. A small air lock, 25 ft. long and 10 ins. in diameter was built into one side of the bulkhead for passing through the lengths of compressed air pipe too long to go through the large locks.

The compressed air was furnished by two Ingersoll 20×24-in. air compressors at each end, from which a 6-in. wrought iron pipe led to the air chamber. It should be said that, except in a few cases, the plant on one side of the river was an exact duplicate of that on the other, and the plant on each side was also in duplicate, so far as was needed to insure against possible delays to the work by the stoppage of machinery. However, in the case of the air compressors, not much advantage was taken of the duplication, for the whole air-compressing plant was kept running night and day, including Sundays, for nearly six months.

At the beginning of the work an air pressure of only 10 lbs. was used. This was increased when bad ground was struck, and some work was done at a pressure of 28 lbs. above atmospheric. Each man underwent a medical examination before he was permitted to enter the compressed air. Cases of the "bends" were numerous, however, and when the pressure was highest three men died from the disease. When the compressed air was first used the escape from the air lock was through a 4-in. globe valve. It was very soon found that with the rapid escape which this permitted, the men would come from the compressed air chamber through the lock altogether too fast for their health, even with the moderate pressures at first employed. A 1½-in. valve was put in its place, therefore; but even with this the men would come through the lock when the air pressure was at 15 lbs. in about two minutes. Doubtless the use of a still smaller escape valve, lengthening the time of passing through the lock to 4 or 5 minutes, would have prevented a large proportion of the "bends." It is true that the cars carrying the material excavated had all to be passed through the locks, and too long delays here would have retarded the work at the headings. It would seem, however, that a lengthening of the time of coming through the lock to five minutes would not have delayed progress.

The loss of compressed air from leakage was generally slight, and the principal draft on the compressors was on account of the air used in working the air locks. Occasionally, however, when gravel was struck there was considerable loss of air, and the water in the river above boiled like a geyser until the porous seam was passed.

Probably some gain would have been made in the progress of the work if the compressed air had been used for the whole tunnel instead of for the part under the river only. The material penetrated before reaching the river was really worse in some respects than that found under the river bed. The clay was so soft that large quantities sloughed in from the top and sides; the cube excavated was sometimes 50% in excess of the actual space occupied by the tunnel. When the compressed air was used, however, the working face stood up much better, and little more than the material in line with the front of the shield was taken out. On the other hand, the 50 men employed in the compressed air at each end were given an increase in wages averaging about $1 per day when work began with the compressed air, and there was the additional cost of running the machinery. On the whole, however, considering the additional safety to the work by the use of compressed air, it would probably have been best to commence its use as soon as the soft ground was struck.

LOCATING THE CENTER LINE OF THE TUNNEL.

The engineering work in laying out the line of the tunnel was of the simplest possible description. Yet it was carried out with the greatest care, for an error in alignment would not have merely increased the cost of the work, as in an ordinary tunnel, but would possibly have caused the failure of the whole enterprise. The whole length of the tunnel and its approaches is a tangent, and the problem, therefore, was merely to lay out this tangent with the least possible deviations from a straight line.

At the open cut at each tunnel portal, on the edge furthest from the river, an instrument station was erected. It was necessary to locate it quite close to the slope of the cutting in order to sight down into the mouth of the tunnel. But from this arose the danger that the position of the instrument might be changed by slow movement of the treacherous clay in which the excavation is made. To guard against this as far as possible, a pit was dug, and a brick pier 3 ft. square was founded at a depth of about 12 ft. This pier was capped at the top with a cut stone block 2 ft. thick, on which the theodolite was mounted; and a comfortable observing hut was built over the whole.

The instruments used were large theodolites, built specially for the work, the one on the American side by Stackpole of New York, and the one on the Canadian side by Troughton & Simms of London. They had 2½-in. object glasses, and could be turned in the wyes to compensate errors from eccentricity of the horizontal axis.

The only object which interfered with a clear sight from end to end of the line was a house on the American side, and this was bought and cut through. Each instrument was adjusted to bisect the object glass of the instrument on the opposite side, 2,100 yds. distant. It was then turned on its horizontal axis to point down into the mouth of the tunnel. An ordinary 7-in. Stackpole transit with shifting head was set here, and adjusted until it was exactly on the line of sight of the large theodolite. The transit was then sighted on the object glass of the theodolite for a backsight and reversed to carry the line forward into the tunnel.

To carry the line through the bulkhead into the compressed air chamber, the following plan was adopted: Into the center of the bulkhead was built a cast iron pipe 1 ft. in diameter and 25 ft. long. This was closed at each end by a hinged cover of heavy plate glass, and was provided with valves at each end so that it formed an air-lock. A strong iron cover protected the glass from injury when not in use. Near each end of the tube were two cross hairs of fine wire, mounted in a ring with horizontal and vertical screws so that they could be adjusted like the cross hairs in a transit.

To get the vertical wires at each end of the tube exactly on the line of the tunnel, a transit was set on the line outside the bulkhead and sighted through the tube. Both the iron and glass covers at the outer end of the tube were opened, and on the inner side of the bulkhead the iron cover was opened and an electric light was held up behind the glass cover to illuminate the cross wires.

After the wires were in adjustment, the transit was taken into the compressed air chamber. The glass cover at the outer side was closed and that on the inner side was opened. The transit was then set up and adjusted by sighting on the cross wires until it was on the center line. It will be seen that all sighting was done on the naked wires, and the possible errors in sighting through glass were avoided.

The preceding description refers only to the location of the line. The tunnel was kept at the proper grade by accurate work with ordinary leveling instruments, and the process of passing the bulkhead was the same as that just described.

Of course, all the work previously described occupied comparatively little time. The principal work of the engineers was to keep the shield in line by frequent observations. Observations were made daily to determine the position of the center of the shield, and see that the plane of the bulkhead was at right angles to the tunnel axis. When the shield was found out of its proper course in either direction, part of the rams on the side toward which it was desired to direct it were left idle when the shield was moved. The deviation of the shield from the proper line or level was never more than two inches.

It will readily be seen that with the type of lining employed it was necessary that the shields should meet accurately at the center of the river. To avoid even the remote possibility of any error in the measurements, the shields were stopped when they were within 100 ft. of each other at the center of the river, and a 6-ft. drift lined with wood was run through the ground between the shields. Through this drift the measurements were made which verified those already described; and when the shields met, edge to edge, the total error in the levels was found to be less than ¼ in., while the error in the line was too small for measurement.

The work of locating the line and levels, and guiding the shields as above described, was done by Mr. T. E. HILLMAN, First Assistant Engineer, assisted by Mr. M. S. BLAIKLOCK, Second Assistant Engineer.

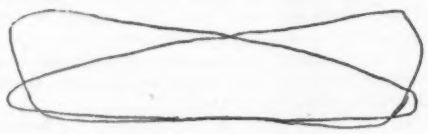
Compound Locomotives on the East Tennessee, Virginia & Georgia Railroad.

The East Tennessee, Virginia & Georgia R. R. has had three compound locomotives, built by the Schenectady Locomotive Works, in service for several months. In the last number of the *National Car and Locomotive Builder* Mr. ANGUS SINCLAIR describes some recent tests of these engines made by him last month, in conjunction with officers of the mechanical department of the road, and we extract from it the following particulars:

The engines in use are two consolidation engines and one ten-wheel engine. Since they have been in service as accurate records as possible of the fuel consumed have been kept, and the officers of the mechanical department conclude from these that the compounds are working with an expenditure of about 30 % less fuel than simple engines of the same class.

The tests were made with one of the consolidation compounds run over the division from Knoxville to Coal Creek, 31 miles, and return, pulling a freight train about as heavy as the engine could handle. Three days later a simple consolidation engine of the same weight and general dimensions as the compound made the same run, hauling about the same train, and the measurements of coal and water

Diagrams taken from H. P. cyl.; scale of indicator spring, 100 lbs. — 1 in.; M. E. P.: front stroke, 50 lbs.; back stroke, 43.3 lbs.



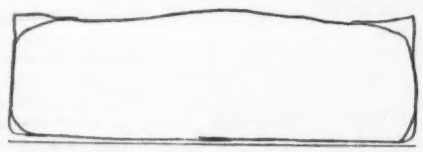
Diagrams taken from L. P. cyl.; scale of indicator spring, 80 lbs. — 1 in.; M. E. P.: front stroke, 42.6 lbs.; back stroke, 42.6 lbs.

Diagrams taken at 26.4 miles per hour; throttle wide open; cut off 18¼ ins.; boiler pressure, 178 lbs.; revs. per minute, 174.

On Oct. 7 the compound engine hauled a train of 32 empty cars weighing 734,050 lbs. from Knoxville to Coal Creek, and returned with 19 loaded cars weighing 1,290,450 lbs. During the round trip the engine used 5,073 lbs. of coal and 41,058 lbs. of water.

On Oct. 10 the simple engine hauled 29 empty cars, weighing 734,050 lbs., from Knoxville to Coal Creek, and returned with 18 loaded cars weighing 1,313,050 lbs. The coal burned on the round trip was 7,040 lbs. and the water consumed was 49,788 lbs. Thus the compound did its work with 72% of the coal and 82.4% of the water used by the simple engine. The compound had 22 tons the heavier load on the outward trip, and on the return the simple engine had the heavier load by 11 tons. Notwithstanding this it is stated that the train hauled by the compound on the return trip seemed to pull harder than the heavier train drawn by the simple engine. The arrangements for measuring coal and water were not satisfactory; the latter was measured in the tank, and no allowance seems to have been made for the inaccuracies in measurement made on curves and grades. The simple engine had two especial disadvantages on the return trip. A car in a preceding train had dropped grease on the rail, and the drivers slipped somewhat on the 4-mile grade, necessitating sanding of the rail. The train was also held twice for orders. The return train

Diagrams taken from H. P. cyl.; scale of indicator spring, 100 lbs. — 1 in.; M. E. P.: front stroke, 90 lbs.; back stroke, 90 lbs.



Diagrams taken from L. P. cyl.; scale of indicator spring, 80 lbs. — 1 in.; M. E. P.: front stroke, 69 lbs.; back stroke, 69 lbs.

Diagrams taken at 2.7 miles per hour; throttle wide open; cut off, 21⅞ ins.; boiler pressure, 171 lbs.; revs. per minute, 18.

INDICATOR DIAGRAMS FROM EAST TENNESSEE, VIRGINIA & GEORGIA COMPOUND CONSOLIDATION LOCOMOTIVES.

showed that the compound did its work with 72% of the coal and 82.4% of the water used in the simple engine.

More full particulars of the tests are as follows: The compound locomotive has cylinders 20 ins. and 29 ins. in diameter and 24 ins. stroke. The boiler pressure is designed to be 180 lbs. and is generally within 10 lbs. of that figure. The driving wheels are 50 ins. in diameter. The high pressure valve has ¾ in. outside lap and ⅛ in. inside clearance; the low pressure valve has ¾ in. outside lap and $\frac{3}{16}$ in. inside clearance. Both valves have 5⅝ ins. travel, the throw of the eccentrics being 5¼ ins. A single exhaust nozzle 5½ ins. in diameter was used.

The exhaust from the high pressure cylinder passes into a horseshoe shaped receiver in the smoke box and thence to the low pressure cylinder. At starting, steam from the boiler enters the low pressure cylinder by means of the Pitkin intercepting valve.

The simple consolidation engine used has 20×24-in. cylinders, carries a boiler pressure of 150 lbs., and has a 6-in. exhaust nozzle. The line from Knoxville to Coal Creek is full of sharp curves and heavy grades. A full train for a 20×24-in. consolidation engine on the division is 18 loaded cars. On one 4-mile grade 11 loaded cars is all one engine can handle, and a pusher has to be used.

The quantities measured in the test were the fuel and water consumption, vacuum in smoke box, steam pressure and speed. Indicator diagrams were taken from the two sides simultaneously at intervals of about a mile, and the positions of the reverse lever, throttle and safety valve were noted.

was too heavy for the compound, however, and it was necessary to double one hill. The vacuum in the smoke box was about 4 ins. of water in the simple engine, increasing to 6 ins. when the engine was pushed very hard. The compound engines had about 1 in. less vacuum. The difference in temperature of the smoke box was so marked as to make much difference in the comfort of those taking the indicator diagrams.

The compound locomotives in ordinary working handle the trains as easily as simple engines of the same size, and they are as easily operated as simple engines; but they are slightly deficient in tractive force on a long heavy pull or in starting a heavy train. The compound consolidation engine with cylinders 20 and 29 ins. and carrying steam of 180 lbs. pressure was estimated to be of equal power to the simple consolidation engine with cylinders 20 ins. in diameter, using steam of 150 lbs. pressure. It was found, however, that the compound engine stalled on a hill with a lighter train than that taken up by the simple engine.

A computation of indicator diagrams taken from both engines when working slowly up a heavy grade showed that the maximum tractive force exerted by the compound was nearly 7% less than that exerted by the simple engine.

The two sets of indicator diagrams accompanying were taken from the compound locomotive, in one case when the engine was running at 26.4 miles per hour, in the other case at a speed of 2.7 miles per hour, in both cases with the throttle wide open.

Light Cable Road Construction.

Under the above title Mr. FRANK VAN VLECK, of Los Angeles, Cal., presented a paper at the Richmond Meeting of the American Society of Mechanical Engineers, describing in detail the single track cable railway lines recently put in operation in the city of San Diego, Cal. The author prefaced his paper with a brief discussion of the relative merits of cable and electric propulsion on street railways. His conclusion was that, "the day of usefulness for the cable on the level is forever gone, and the electric road stands champion of the field." For roads on steep grades, however, he maintained that the cable system was the best, notwithstanding claims of electric engineers that their roads could ascend grades as steep as 16 per cent.

The San Diego road was originally operated by electricity, but after running about a year it was abandoned as a financial failure. The franchise and equipment were purchased by a new company, and it was determined to build a single track cable road, as cheaply as was possible, consistent with good work, because the traffic to be carried was rather light. A single track cable railway is necessarily much more complicated than a double track line. The latter has but one cable in its conduit, moving always in the same direction. In the conduit of the former, two cables, side by side, hurry in opposite directions; and the grip must be capable of holding to its proper advancing cable and not to the other. Curves present a maze of difficulties, for the two cables running in opposite directions cannot pass around the same curve pulley at the same time. The author continues substantially as follows:

PERMANENT WAY.

The foundation of a cable system is the road substructure; the iron yoke binds the rails to the concrete foundation and shapes the conduit. The fact that there is never any frost in the ground in this part of California had much to do in lightening the form and cross-section of the yoke, which is shown in Fig. 1.

The form of the central conduit was determined by the following considerations: The two cables in the conduit must not be so close together as to chafe each other in oscillating sideways, nor to touch the rims of the sheaves carrying the opposite cable; nor, again, must they be so far apart as to swing against the concrete sides of the conduit, or so close to those sides as to render difficult the passage of the grip, which must embrace the cable from the sides. The sizes and position of the sheaves carrying the cable also had to be considered. Drainage had to be provided below all, to allow free passage of water and dirt below both cables and sheaves—for Southern California, though somewhat of a semi-arid region during most months of the year, does have rain sometimes during the winter months; and when it does rain, vast volumes of water fall in short spaces of time. In such cases cable roads may run like small sewers, and not to make provision for water would be ruinous to the cable; for the grit thus carried about and into the strands of the cable is doubtless a prominent factor in decreasing its life. Finally, the cross section of the grip must determine the main form of the conduit, for the grip must pass every point of the road, and must be capable of taking the proper rope only at the proper level, and according to the position in which the car is headed. Therefore, in a road of this kind, it was necessary that, even before any other mechanical details were determined upon, the grip itself should be designed, or at least the form of its cross-section unalterably fixed. The form of conduit thus derived will be observed to depart from the usual practice of double-track roads, in that the grip necessitates an angle in the side of the conduit where ordinarily is but a straight side, as seen at *A*, Fig. 1.

Following the example of numerous other cable systems the managers decided to adopt the 3 ft. 6 ins. gauge and would even have decided for 6 ins. less and reaped further benefit of still diminished cost of construction, had they thought that public sentiment would look with favor upon such a narrow gauge in a city already compassed by the wider standard gauge. The outside width of the yoke being thus determined by the gauge, the yoke as completed is somewhat of a V form with the bottom rounded. The conduit or tunnel extends to within 6 ins. of the bottom From the figure it will be seen that the tendency of the yoke to close is resisted mainly by the metal in the cross section at the bottom of the conduit; this, therefore, was given as much iron as could be conveniently done in a yoke of so light a weight—150 lbs.

The rail used is 25 lbs. per yd., and although light for cable-road service, yet because large quantities were left as an heirloom by the old electric road, it was decided to use it for whatever might be its term of life, and then, if the traffic so demanded, lay a heavier rail. T-rails can never be regarded as the best tramway section to lay in a city street, yet where the paving outside is close to the head of the rail, and the paving inside is at the height of

the top of the rail, with but a flange groove between rail and paving, the objections to the T-section almost disappear. This was easily arranged, as the paving between rails on the entire road is of asphalt, or what is more specifically termed on the Pacific, bituminous lime rock.

The slot-rail (*Z*, Fig. 1) is a special section rolled for this road, the desire being to secure the lightest possible form, which would be inexpensive to adjust, and one which should avoid what with many other roads has been inevitable—the use of paving plates. What are known in cable construction as paving plates are strips of cast or wrought iron extending from yoke to yoke, near the slot rail, to prevent the concrete from being pushed from its sharp angle into the conduit or tunnel. This matter of paving plates alone is one which may effect the cost of a mile a thousand dollars or more.

A few cable roads have attempted to save a considerable amount by the abandonment of concrete as a binding medium to hold yokes and roadway together. Although this saving may be material in first cost, yet the expenses of general repairs and the hosts of nuisances from bad alignment and closing slots render it unsuited for a satisfactory system. Therefore it was early decided to use concrete throughout this new system, but not in such large cross-section as would require a heavy outlay. The external bounding of the concrete cross section follows the outline of the yoke, except that at the bottom the concrete is run 3 ins. below the yoke for the purpose of forming a better foundation, and a bond between the contiguous blocks of concrete between yokes. This concrete was formed with 3 parts sand, 6 of broken stone, aud 1 part of best English Portland cement. The mixing was in all cases done on the road, beside the work, and the concrete was at once thrown into position between the yokes in the trench, and thoroughly tamped.

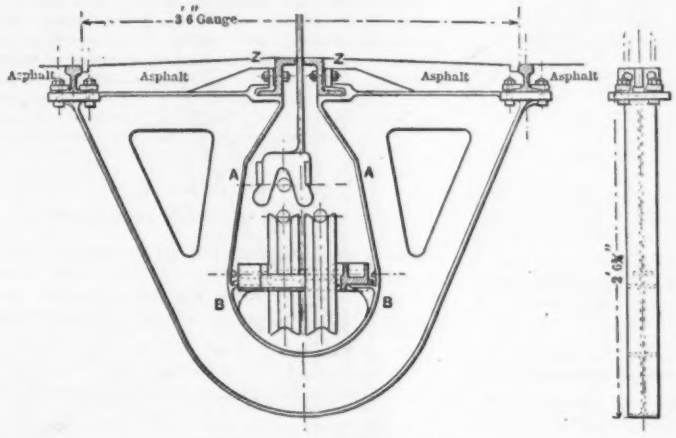


FIG. 1.—STANDARD YOKE.

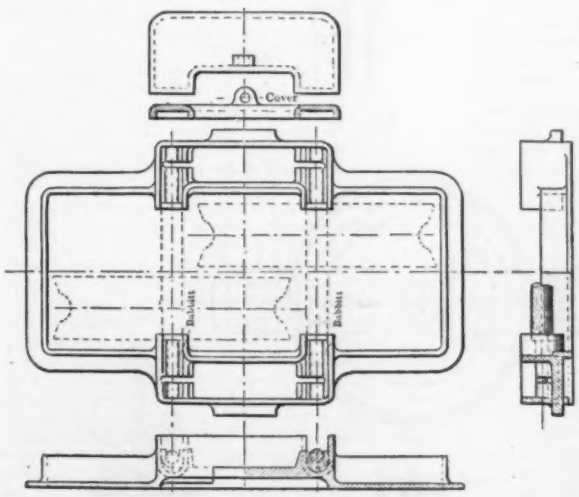


FIG. 2.—SHEAVE FRAME.

Yokes were spaced at 4 ft., center to center, and at every tenth yoke was placed a "pulley yoke," such as is shown in Fig. 1. The plain yokes do not have cast on their conduit curve the two brackets shown at *B*, *B*. Therefore, in single-track cable systems it has been the custom to place a pulley sheave on one yoke, and on the next yoke another pulley for carrying the opposite-going cable. This requires two yokes to be prepared for the reception of the pulley boxes, and then on each yoke two boxes are to be attached, usually by bolting, and brought into proper alignment. To make each of these two pulleys with their four boxes accessible from the street, required either two manholes through the paving or one long and expensive manhole spanning from yoke to yoke.

By the system here employed for the first time, both pulley shafts are brought close together, and can therefore be carried in a single frame—see Fig. 2. This frame surrounds and carries both pulleys. Having both in the same frame, whenever the frame is adjusted to proper position, then all four bearings are in correct line. This frame is simply passed in over the brackets attached to the yokes until it comes to its mid-position, when a depression in the pulley frame drops over the bracket; if, then, a thin wedge-shaped piece is driven in on each side, the frame is rigidly held to place, and can neither back out nor move forward. Another advantage of this frame-carrying device is that the oil box on one side embraces both journals; thus, one oiling oils the two shaft ends. It also affords a large receptacle for containing the oil or oil waste, or "dope." The whole thing is also readily accessible from one small manhole in the street.

The small carrying sheaves, Fig. 3, are 10 ins. in diameter, with a 3-in. face, and are mounted on cold rolled steel shafts about 12 ins. long. The sheaves are of cast iron throughout. To the uninitiated in cable work it appears strange that cable engineers persist in letting expensive steel cables wear themselves out by passing along and around wheels whose surface is hard cast iron, while theory would dictate the practice of using a softer material for this rope to run on. Some roads do indeed use sheaves with grooves filled with Babbitt or wood. Whether such use has lengthened the life of the cable appears to be doubtful, while its manifest disadvantages have been often too evident. The great disadvantages are, greater wear and consequent frequent renewal of the softer material and the greater difficulty experienced by the soft wheels taking the "lay of the rope." This latter is an effect which all cable men seek to avoid. When a cable is considered in its best condition, its depressions between contiguous strands are uniformly filled with tar or pitch, so that the appearance of the cable is not unlike a well tarred gas pipe. In this condition it resists better the wearing action of sand or grit, which may chance in the conduit, and is far smoother in its action in passing through the jaws of the grip. When a wheel or sheave takes the "lay of the rope" it has formed in its groove the matrix of the cable or the opposite of the space between strands. This matrix gradually increases its resemblance to the space between strands, with the consequence that it pushes all the tar from between the strands, thus setting back the cable to its original naked condition. When such a wheel or sheave is found it is promptly taken from the road and thrown away, or the groove, if the stock in the rim permits, is re-turned.

The manhole through the paving whereby the oiler has the opportunity to perform his duties is perhaps smaller in this road than any other. As this is a detail of constant repetition, it is evident that five or ten dollars saved in its construction means a comfortable saving at the end of the road. The size is only 12 ins. × 14 ins., yet a small man or youth can pass through it and along the conduit of the road. During the progress of construction on many roads it is desirable or necessary that a man should pass into the conduit for the purpose of bolting up parts or attaching sheave supports, but on this road all can be done from outside, even to the attaching of the pulley frames, for neither do these or other internal devices require any work of bolting. Practically, then, the main and only use for these manholes is for oil holes. The manholes and frames are shown in Fig. 4. Although made of cast iron, they are so braced as to give maximum strength. Not one of them has yet been broken by heavily loaded wagons, fire engines, or road rollers.

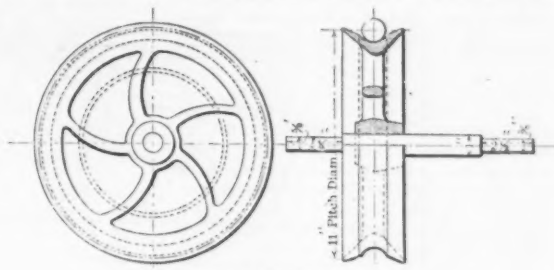


FIG. 3.—CARRYING SHEAVE.

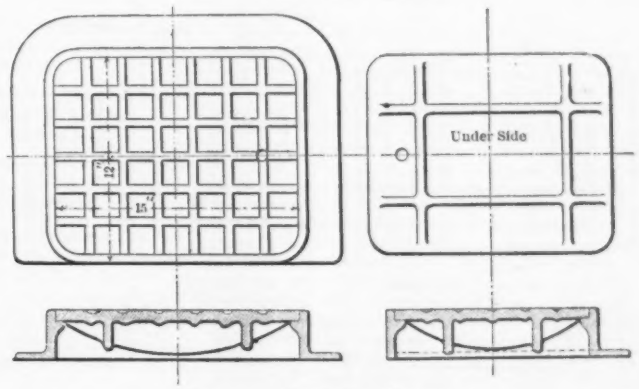


FIG. 4.—MANHOLE FRAME.

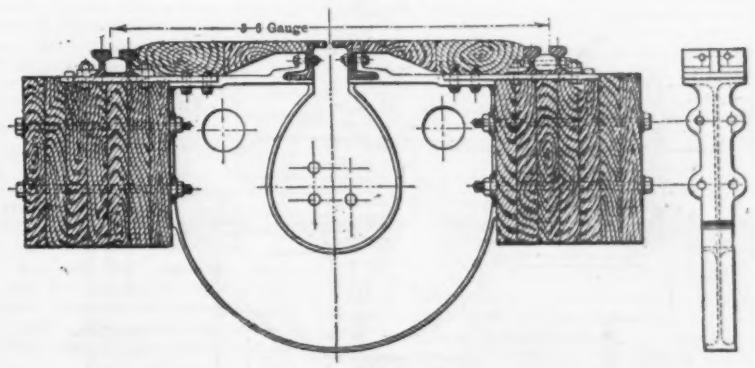


FIG. 5.—BRIDGE YOKE.

The line of the road in two places crosses deep gullies in one of which the roadbed is some 70 ft. above the bottom of the ravine. In both of these cases high wooden bridges have been built. As it was possible for vehicle traffic to come upon these bridges, it was decided not to leave the space between rails open. The problem was presented, therefore, to carry the slot rails in the center and any load which might come between rails, preserving accurately the gauge distances between all rails, and to have the yoke so formed that it might be afterward filled with concrete, should the ravine be filled and graded. The yoke devised for this purpose is shown in Fig. 5. This yoke was given a little more metal through the central section in order to resist closure, should heavy loads come upon the slot rails, and in this case it was the more desirable, as no concrete was here used to bind or to strengthen the yokes. The ravines

over which these bridges pass will probably be filled and graded to the proper street level later, when these yokes can be arranged for the usual track work by attaching a triangular bracket to each side of the yoke and under the rails, and then filling with concrete in the usual manner.

THE CURVES.

Scarcely any street railway can be built without curves, and these to the cable system are perhaps a necessary yet an unmitigated nuisance. Costly to a degree which makes stockholders sigh, they are a source of endless care and anxiety to the management, and besides all that, they cause further expense by eating the life from the cable. Curves are bad enough for the double-track systems, but with a single track the difficulties increase. For how shall these two cables, moving in opposite directions, pass around the horizontal curve pulleys? Both cannot run on the same sheave, for no wheel revolves in two directions at once, nor can alternate pulleys be used for either rope. Practically there are but two methods for accomplishing this feat. The method first made use of was to carry one rope at a higher level than the other, and have it pass over curve pulleys above the pulleys carrying the opposite moving rope. This required that the gripman, when having the lower rope, must invariably release his rope from the grip, and then let his car "float" over the curve either by momentum or gravity. Usually these curves were located on a grade in order to make use of gravity to carry the car around. In these cases, when the gripman did not release and drop his rope, the grip from its construction carried the rope into the wrong pulleys, and trouble ensued at once. To add to the difficulties, after passing the curve provision must also be made for picking the rope up, for grips as usually constructed have not the power to go down after the cable.

The other solution of the problem is to separate the ropes and to construct the curves as double tracks. This was necessary in the road described, as no curve was on an incline which could be depended upon to float the car over by gravity. As a single-track road requires a certain number of passing places or turnouts, these double-track curves were so arranged on the line as to serve this same purpose of passing places. Fig. 6 shows in diagram the manner in which one of these curve turnouts was arranged. This is a right angle curve, where the turnout is located on the inside of the curve. It will be noticed that the inner curve is not included by the same angle as the outer one. This was caused by the fact that this arrangement would give a short piece of straight track between the ends of the inner curve and the switches, thus doing away with a number of curve pulleys and their corresponding disadvantages.

The turnouts, whether arranged as thus indicated for the curves or whether constructed at the side of the straight track, invariably have the moving cable led through them to insure that the car will always be able to move in its proper direction. The entrance to a turnout on the straight is shown in Fig. 7. This diagram also indicates the manner in which the slot is deflected from the center line in order to insure that the grip will not strike the curve pulleys. At no point on the road between termini, except at the power station, does the grip have to let go the cable. Thus at all points, whether on curves, turnouts or switches, the car can always retain its rope. This releases the gripman from a vast amount of responsibility and insures greater safety for the passengers.

The yokes for the curves were of quite different form from the yokes for the tangents, as the former have to take strains which do not come on the latter. The form of curve yoke is shown in Fig. 8. The main outline of the yoke is in the form of a square, for the purpose of strength and for holding a greater body of concrete than such a depth of yoke would if made in the V form. For if concrete in sufficient mass has not been put in a curve, the curve has been known to be either pulled up or out of shape by the heavy tension of the cable. The conduit, it will be noticed, is shallower than the straight yoke; this is due to the fact that each alternate curve yoke is fitted with a wooden block whose top surface is but a short distance from the cable. As this impedes the flow of water through the conduit, it was decided to form the channelway for water under the frames for the pulleys, where it might have unobstructed flow, which space, of necessity is left unfilled with concrete, for the action of the curve pulley. The yokes as thus constructed, when concreted up, form a rigid construction capable of withstanding any of the strains to which curves may be subjected. The frame which carries the pulley is attached between two brackets cast on the yoke at *A*. The grip is prevented from being drawn against

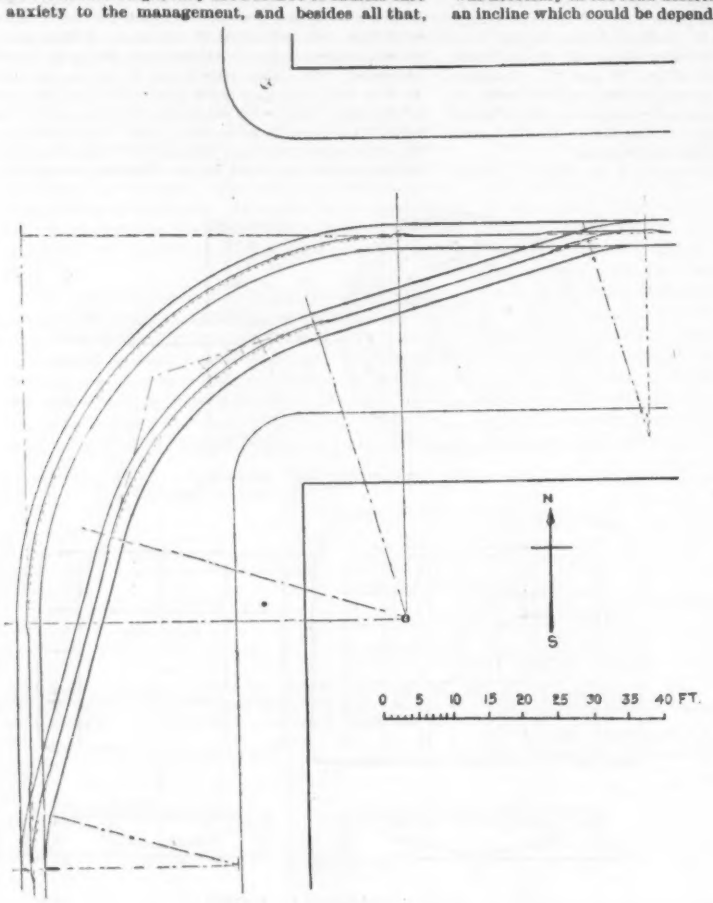


FIG. 6.

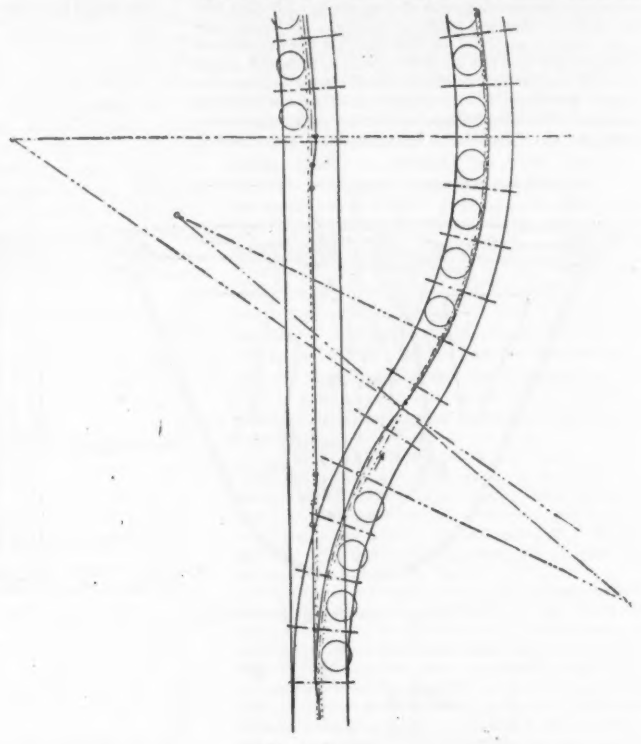


FIG. 7.

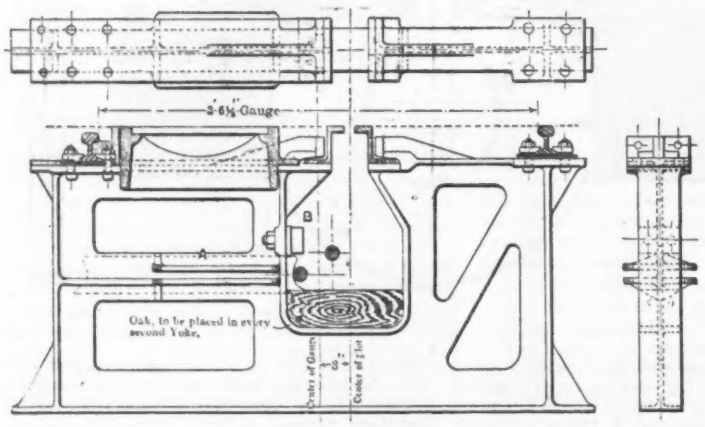


FIG. 8.—CURVE YOKE.

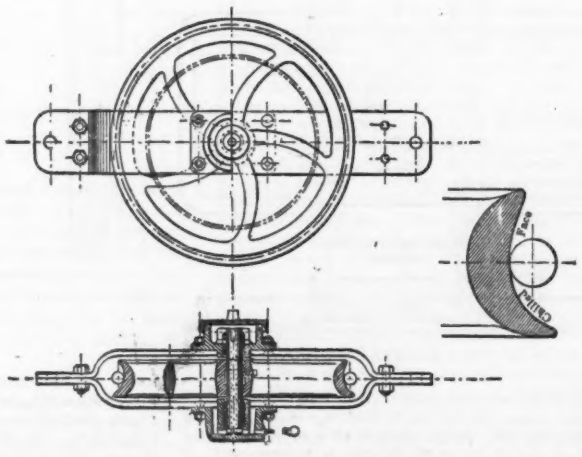


FIG. 9.—CURVE PULLEY.

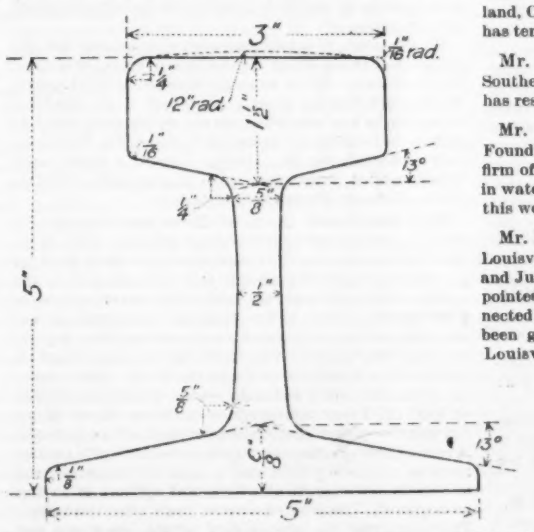
the pulleys by the grip guard at *B*, against which the grip slides in its entire passage about the curve. The grip, previous to its entering the curve, is deflected 3 ins. to the outer side by a deflection made in the track slot to that amount. This permits the cable to run directly from the tangent to the first curve pulley in its own proper line, while the grip by this means is carried to one side enough to clear the pulleys, and the strain imposed upon the grip by this bending is taken by the grip guard mentioned.

The curve pulleys are carried between each yoke by the special frame of wrought iron shown in Fig. 9. These pulleys are of cast iron with chilled rims, the width of rim being but 3½ ins. This narrowness of rim is made possible by the fact that the rope is lifted but 3 ins. by the passage of the grip, and consequently after the grip has passed the rope falls to its mid-position on the sheave. Even should the rope come higher, it could not remain above the rim of the sheave, due to the presence of the grip guard. As these sheaves are so small in width it is deemed cheaper to renew the whole sheave when worn than to use a larger pulley with a renewable tire. The diameter of the wheel is 22½ ins. on the pitch circle, thus striving to attain what is at present considered best cable practice, "as large curve pulleys as possible, and spaced as closely as yokes permit." The distance from pulley center to pulley center is about 3 ft. The details for keeping the journals of these pulleys thoroughly lubricated will be seen from the drawing. Above each pulley is placed a manhole of sufficient size to permit of the removal of the pulley and its frame complete.

(To be Continued.)

Suggested Flat Top Rail Section.

The accompanying illustration shows a section for an 80-lb. flat top rail section proposed by Mr. JAS. CHURCHWARD in a recent interesting and in many ways meritorious paper before the Society of



SUGGESTED FLAT TOP 80-LB. RAIL.

Scale, 1-2.

Railroad Superintendents. It is notable for the great width proposed, but the chief reason for re-engraving it is to add to the top of the section a dotted line showing how much effect a 12-in. top radius in lieu of a flat top has, even in this wide section. Two queries cannot but suggest themselves: 1. Which form of top is likely to fit the *average* wheel best? 2. If there be a difference of fit, how long is it likely to continue?

University of Pennsylvania—Road Prizes.

As announced some time ago, the University of Pennsylvania, acting for a committee of citizens of Philadelphia, offered prizes amounting to $700 for the best papers on road making and maintenance A large number of contributions were received and referred to the following committee: A. J. CASSATT, WM. SELLARS, JOS. M. WILSON, W. H. WAHL, THOS. M. CLEEMAN, Hon. WAYNE MCVEAGH, and Prof. LEWIS M. HAUPT.

This committee, of which Mr. A. J. CASSATT was Chairman and Prof. LEWIS M. HAUPT, Secretary, has now awarded these prizes as follows: First prize of $400 to Mr. HENRY IRWIN, B. S., C. E., Asst. Eng Canadian Pacific R. R., Montreal, Canada; second prize of $200 to Mr. DAVID H. BERGEY, B. Sc., M. D., North Wales, Pa.; third prize of $100 to JAMES B. OLCOTT, South Manchester, Conn. The following papers received honorable mention without reference to order: to Edwin Satterthwait, President of the Cheltenham and Willow Grove Turnpike Co., Jenkintown, Pa; Charles Punchard, Philadelphia, Pa.; George B. Fleece, C. E., Memphis, Tenn.; Frank Cawley, B. S., Instructor in Engineering, Swarthmore, Pa., and Francis Fuller McKenzie, C. E., Germantown, Pa.

The prize papers, a careful digest of the other papers and a short paper by Prof. HAUPT, discussing the general features of these contributions, has been copyrighted by Mr. WM. H. RHAWN, Chairman of the Citizens' Committee, and the book will be published and sold at $2.00 by Henry Carey Baird & Co., Philadelphia. The proceeds are to be devoted to an extension of the work of the Committee. The book will be ready in December.

PERSONAL.

Mr. GEO. G. BYWATER, Master Mechanic of the Utah division of the Union Pacific Ry., has resigned. He will be succeeded by Mr. A. C. HINCKLEY.

Mr. A. H. HOGELAND has been appointed Engineer of Maintenance of Way of the Great Northern Railway line, with headquarters at St. Paul, Minn.

Mr. W. C. IRWIN, Chief Engineer of the Cleveland, Columbus, Cincinnati & St. Louis Ry., (the Big 4), has tendered his resignation to take effect Dec. 1.

Mr. GEORGE J. HEIM, Superintendent of the Southern division of the Gulf, Colorado & Santa Fe Ry., has resigned. He will be succeeded by Mr. S. S. MORRIS.

Mr. DANIEL RUNKLE, President of the Warren Foundry & Machine Co., Phillipsburg, N. J., and of the firm of Runkle, Smith & Co., New York, organized to put in water-works at Havana, Cuba, died at Plainfield, N. J., this week.

Mr. E. B. STAHLMAN, Third Vice-President of the Louisville & Nashville R. R., has resigned his position, and Judge W. J. WOOD, of Evansville, Ind., has been appointed his successor. Mr. STAHLMAN has been connected with the road for some years. Judge WOOD has been general solicitor for Indiana and Illinois of the Louisville & Nashville R. R. for several years.

Mr. ROBERT GORDON, M. Inst. C. E., M. Am. Soc. C. E., late Government Engineer, of Siam, has returned to England for the present. The Bangkok-Korah railway, 165 miles long and located under Mr. GORDON, has been let to a German syndicate and will be built under Mr. BATHZE, one of Mr. GORDON'S staff. German rails and machinery will be used and German engineers will generally conduct the work. This will be the first railway in Siam, and the estimated cost is $5,000,000.

Mr. L. D. BUTTON, formerly Superintendent of the Kanawha & Michigan Ry., has been appointed Superintendent of the Kansas division of the St. Louis & San Francisco Ry. Mr. W. A. THOMAS, Superintendent of the Texas division, has been transferred to the St. Louis division, vice Mr. E. L. FAY, resigned. Mr. J. R. WENTWORTH has been appointed General Superintendent of the Eastern division.

Col. W. E. CUTSHAW, City Engineer of Richmond, Va., is one of the most striking personalities of that city. Seventeen years of faithful and single-hearted devotion to the development of the city has so welded his power in the minds of the people that he is practically autocratic. With exceedingly limited appropriations, and the usual aldermanic interference in public works, yet COL. CUTSHAW has held on his way until at the present time the evidences of his good judgment and his honest "despotism" are shown in the streets, sewers, water-works, parks and public buildings of Richmond. COL. CUTSHAW is a graduate C. E. of the Virginia Military Institute, of which college, after four years service in the Confederate army, he was a professor of civil engineering until in 1873 he was appointed City Engineer of Richmond, which office he has held continuously up to date. Richmond is very much like Providence, R. I., in the matter of public works. The City Engineer has charge of everything.

NEW PUBLICATIONS.

The Johns Hopkins Hospital.—A description by JOHN S. BILLINGS, M. D. Baltimore, 1890. This exceedingly handsome quarto volume of 116 pages of text, and as many more of most excellent illustrations, is one of the publications of the hospital itself, printed by resolution of the Board. Dr. BILLINGS, of the U. S. Army was the medical advisor to the President and Building Committee, and the work was prepared by him at the request of the Board. Probably no hospital building in the world was started under more favorable circumstances for insuring superlative results. The Johns Hopkins fund for the erection of this hospital and a home for colored orphans amounted to $3,000,000. Before proceeding to build, the committee having this matter in charge obtained advice from a board of five physicians selected from the whole profession for having made a special study of hospital requirements. The practical result of the careful work of the trustees of the fund is that 17 separate buildings have been finished and 14½ acres endowed and beautified without touching the principal; in fact, the sum of $113,000 has been added thereto by judicious investment and management. It should be mentioned, however, that the site was purchased by Mr. HOPKINS himself. And the only criticism we would make, from a personal inspection, is that while the exact cost of the structure is not stated in this report, the cost per bed for patient capacity must have been something enormous. The compensating feature is that every comfort and convenience is provided for, and the patient is in one sense fortunate who can claim the care and perfect attention here lavished upon him.

The arrangements for heating and ventilation seem to be perfection itself, and commend themselves as the chief engineering features in the buildings. The heating of certain departments is done by a circulating system of hot water pipes containing about 175,000 galls. of water. In all private or isolated rooms and in all living rooms in the administration buildings, open fire-places are provided, but will be but rarely used. The amphitheatre, dispensary, bath houses, pathological laboratory and laundry are heated by steam. The hot-water or main-heating plant is fed by six boilers, and is practically a closed circuit of pipes located in a pipe tunnel connecting all the buildings. All pipes are covered with felt, enclosed in asbestos paper and finally in stout canvas, thoroughly painted. As a consequence very little heat is lost in transmission, though one heating coil is 763 ft. away from the feeding boilers. With a temperature of 92.6° F. in the flow pipe and 85.4° F. in the return, the rate of flow is 13.5 ft. per minute, as determined by a by-pass on one of the smaller supply mains. Part of this by-pass is a glass tube of the same diameter of the pipe, and the velocity is measured by injecting a small quantity of a solution of carmine and noting the time required to pass a measured distance in the glass tube. With a temperature of 134.8° F. in the flow and 129.7° F. in the return, the velocity was found to be 16 ft. per minute.

The ventilating arrangements are closely connected with the heating apparatus. The external temperatures at the hospital have a range of from 102° F. in summer to −6° F. in winter. To meet these wide extremes in the wards occupied by the sick, the sizes of flues and registers, and the amount of heating surface have been arranged for a supply of 1 cu. ft. of fresh air per second to each person in the ward, with the possibility of doubling this amount in flushing out the ward. In the separate rooms the supply is 1½ cu. ft. per second per head. In the isolating wards, where, owing to the nature of the diseases treated, more air is desirable, 2 cu. ft. per second are provided for. For all the wards the air is warmed, in cold weather, before it is admitted. The registers and fresh air flues are proportioned to pass the required amount of air with a velocity not exceeding 1½ ft. per second under ordinary circumstances. Air currents of this velocity, at a temperature of 70° to 75° F., are barely perceptible to the hand. The fresh air registers as a rule are placed 9 ins. from the floor, with one register to each pair of beds, with adjusting valve.

The sewage disposal was troublesome, as Baltimore has no system of sewerage properly so-called; all soiled water passes into the gutters and excreta are discharged into wells, cesspools or boxes. In the hospital the water-closet and ward sink sewerage was kept distinct from that coming from the kitchen sinks, wash-basins, etc. All this sewerage passes into a system of iron pipes leading to a well on the grounds. This well is 7 ft. in diameter and 71 ft. deep, with a stratum of coarse gravel and pebbles at the bottom through which ground water is slowly passing. At right angles to the direction of this subterranean stream drifts were excavated 15 ft. on each side of the well, 2 ft. wide and 5 ft. high, and lined with brick laid in cement for sides and crown. The bottom of these drifts is the natural gravel. The well is ventilated by a pipe carried to the ventilating shaft on one of the buildings. While it is admitted that this is not an ideal method of sewage disposal, it was adopted as a temporary expedient until the city shall build a proper sewerage system.

—*Statistics of Railways in the United States.* Second Annual Report to the Interstate Commerce Commission for the Year ending June 30, 1890. HENRY C. ADAMS,

Statistician Int., Commission. Pub. Doc., 8vo., pp. 566, 483 pages tables. Particularly well indexed.

The advance sheets of this admirable report, which is a great advance in many ways upon the first issue of last year, we noticed some weeks ago (ENG. NEWS, Aug. 23 and Sept. 27, 1890). The volume now before us is enlarged only by the tables for individual railways, which add little of general interest for review although adding greatly to the bulk of the volume. While perhaps a trifling feature to speak of first, it is with no small pleasure that we note that a successful effort has been made to show that, because a book is a Pub. Doc., and cheaply bound, there is therefore no necessity to have its binding ugly nor the lettering on it atrocious.

The detail tables cover (I.) for 1,705 separate companies, the length operated, length owned, new lines built and gauge, with a full column of "Remarks," giving the nature of the road, terms of lease, if leased, etc. The leased lines are grouped under the main company, but separately numbered. There are only 609 actual operating companies, 173 of whom are, like the Pennsylvania Company, for example, actually subordinate organizations. This leaves only 436 actual independent companies, and of these a great number are, like the various Vanderbilt lines, for example, unified in management *de facto*, although not *de jure* in any form which official statistics can take cognizance of. A supplement to the table shows that 163 roads whose names appeared in last year's report have disappeared this year, of which number 25 disappeared by consolidation, 41 by merger, and 25 by reorganization.

Table II. gives full financial details of stocks, bonds and floating debt, and amount per mile of the total for each company, the variations being startling. Table III. gives details of earning under 7 different heads. The deduced statistics given for each company are receipts per passenger mile and ton mile, and per freight and passenger and total train mile, and the percentage of passenger, freight and other receipts. Table IV. gives details of operating expenses in 21 columns, the expenditures being divided under four different heads only, however. The cost of maintenance of way averages 22.46% for the whole United States together, showing a slight tendency to decrease from the average of past years.

Table V. shows in detail for each road the payments on capital, and Table VI. a "summary of financial operations" for each company, giving first the amount to be accounted for under 5 heads,* and the income accounted for under 6 heads.† It is needless to say that until quite recently this information was not to be found in print for many of the companies. Then follows the elaborate index, and this closes the volume, which is perhaps as complete as could reasonably be asked. It would be much bettered, however, by giving totals for sections of the United States as well as the grand total only, by reproducing some of the figures from past years for comparison, and especially by going further into details as respects accidents to trains and persons.

—*Proceedings of the Connecticut Association of Civil Engineers and Surveyors*, Aug. 29, 1890, Pamph., pp. 24.

This report contains a paper by E. H. PHIPPS, C. E., entitled "Remarks on Hydraulic Pipes." Special reference is made to the wrought iron and cement pipe manufactured by the Connecticut Pipe Manufacturing Co., of West Haven, Conn. The meeting at which the paper was presented, was held at the office of the company, and the paper contains a brief description of the process of manufacture of this kind of pipe. The report also contains a sketch of the life of the late F. FLOYD WELD, C. E., past president of the Association, and a report of the special committee on dams and reservoirs, presented by the chairman, N. J. WELTON, C. E., Waterbury, Conn. The committee reviews briefly, the provisions of the Connecticut, Rhode Island and Massachusetts laws regarding dams and reservoirs, and recommends that the Connecticut laws be amended so that in case a dam or reservoir is deemed unsafe and application for an examination is made to the town or city officials, the latter shall at once call upon one or more of the Board of Engineers to examine the structure, the present provision being that the town or city officials first examine the dam or structure and then call upon one of the Board, at their discretion. They also recommend that all new dams be built under the supervision and inspection of an engineer, that the engineer shall inspect the work as often as he may deem necessary, instead of "at least three several times" as now provided; that there be provision for an inspection of each dam in the State at least once in three years; that there be a specific penalty named in the law for failure to comply with its provisions. In addition the committee think it well to provide for an appeal from the decision of one member to the whole Board. A full copy of the law is appended to the report. Comments upon the laws of these States were made in ENGINEERING NEWS, Vol. xxii., pp. 178, 182, and vol. xxiii., p. 355.

* Net income from operation, income from bonds and stocks owned, increase of permanent liabilities, increase of current liabilities, decrease of current assets.

† Assigned to pay fixed charges, reduction of permanent liabilities, decrease of current liabilities, increase of current assets, net betterments, miscellaneous expenditures, assigned for payment of declared dividends.

—*Engineer's and Commissioners' Report on the Construction of a Sewerage System for West Troy, N. Y.* CADY STALEY and GEORGE S. PIERSON, Engineers. Pamph., pp. 35. Map and illustrations.

This pamphlet is largely taken up with a full description of the sewerage system by the Constructing Engineer, GEORGE S. PIERSON, prefaced with data by the Engineer, CADY STALEY. In addition the Sewer Commission reports on the financial features of the undertaking, and gives the rules and regulations governing house connections. The report of Mr. PIERSON is very complete, and is supplemented with cuts showing details of manholes, fresh air inlet and hand holes.

—*Institution of Civil Engineers.* Calorimeters for Testing Fuels (for heat units) on a Small Scale, by BRYAN DONLAN, Jr., and JOHN HOLLIDAY, pp. 15. Effect of Chilling to zero Fahr. from various high temperatures, and slowly and quickly) on the Impact Resistance of Metals, by THOS. ANDREWS, pp. 21. Abstract of Papers in Foreign Transactions and Periodicals, pp. 97.

—*International American Conference.* Reports, Recommendations and Messages. Pub. Doc. 8vo, pp. 350.

This volume is the official record of this conference, and naturally contains a good deal of technical and statistical matter relating to the various American nations, which is not elsewhere so conveniently accessible. A large part of the volume is occupied by maps and records relating to the inter-continental railway project.

—*Selected Papers of the Civil Engineers' Club of the University of Illinois.* 1889-90. Champaign, Ill. 8vo, pp. 63; numerous cuts and tables; 30 cents.

This is one of the most creditable and practical collections of papers which we have ever seen in a college publication. No less than 3 of the 14 papers contained in it have been selected for nearly full reprint in our columns, and most of the remainder are as deserving, though not so 'available."

—*Twenty-first Annual Report of the State Board of Health of Massachusetts*, 1890. F. P. STEARNS, Chief Engineer; S. W. ABBOTT, Secretary. Pasteboard, pp. 457, maps, diagrams and tables

The matters of special engineering interest in this report to the letters of advice to various cities and towns regarding water supply and sewerage, analyses of ice and water made during the year, and some remarks on water supply and sewerage in the extracts from the reports of the various local health boards. Over 30 applications were made to the board in the year under consideration for examinations of or advice regarding water supply, and about 15 similar applications were made regarding sewerage. All petitions to the Massachusetts Legislature for authority to introduce water supply, drainage or sewerage must be accompanied by the recommendations of the State Board of Health regarding the same. This is a provision which cannot be too highly commended. Some idea of the work of the Board in relation to water supply and sewerage can be gained from the fact that its expenses during the year for these purposes was $26,534, over $17,000 of which was for salaries.

—*Twelfth Annual Report of the New Orleans Water-Works Co.*—L. H. GARDNER, Superintendent, April 2, 1890. Pampt., pp. 25.

This is one of the very few reports regarding private works that come to us. Aside from the usual matter, it contains complete and valuable pumping statistics for the year.

—*Annual Report of the Sewer Commissioner of St. Louis.*—ROBERT E. MCMATH, Commissioner. Pamph. pp. 36.

If general interest in this pamphlet we note the sub-report of B. H. COLBY, First Assistant Engineer, on the work of triangulation and establishment of precise levels within the city; also detailed statistics regarding the sewers constructed during the year, and from 1876-7 to date; and finally a table showing the results of tests of 316 samples of cement taken from 12 brands.

—*Annual Report of the Water Commissioner of St. Louis.* M. L. HOLMAN, Commissioner. 1890. Pamph. pp. 30, large diagram on folding sheet and illustrations.

The large diagram in this report shows the average daily consumption per month and the average yearly consumption for the 19 years 1871-2 to 1889-90, inclusive, an increase in the former from 10,500,000 to about 33,000,000 galls. The illustrations, four in number, are photographic reproductions of views of the conduit for the new low service supply. They show the bridges carrying the conduit over Mohne, Horse, and Harlem creeks, the former view showing the shell and heading of the conduit and the end of section B, looking in.

TRADE PUBLICATIONS.

—*Wedding's Basic Bessemer Process.* Translates from the German, with permission of the author, by Wm. B. Phillips, Ph.D., and Ernst Prochaska, M. E. Price, $3.50. Announced as in press by the Scientific Publishing Co., New York City.

—*Lacy Manufacturing Co., Los Angeles, Cal., makers of riveted iron and steel pipe, iron tanks, etc.*—A very creditable trade catalogue, giving sections and forms of riveted steel and iron pipe, with driven and banded joints, reducers, curves, elbows, crosses, tees, etc. The catalogue also shows the form of irrigating hydrants made by thid company, equalizing valves, air and globe valves, etc., of the same make. Tables given and other contents make it especially useful in irrigating sections of the country.

SOCIETY PROCEEDINGS.

Polytechnic Society of Utah.—At a meeting at Salt Lake City, Nov. 7, the President, C. L. Stevenson, C. E., made an address regarding the aims and needs of the Society, which wishes to include all members of the engineering, architectural and kindred professions in the city and vicinity.

Liverpool Engineering Society.—Meeting of Oct. 29. Mr. Henry H. West, the retiring president, introduced Mr. Ferdinand Huddleston, the newly elected president, who delivered his inaugural address. Mr. Huddleston described the general engineering features of the Mersey Dock Estate, commencing with the old dock, opened in 1715. He incidentally mentioned that the datum of the Ordnance Survey of England was based upon the level of the old dock sill. In speaking of the pumping plant, he described the Coburg pumps. There are three independent centrifugal pumps, with 54-in. diameter suction and delivery. Each pump is driven by a compound condensing engine, and the three together deliver about 1,200 tons of water per minute, and indicate 2,000 HP. when working at full lift. Their work is to keep 80 acres of old docks at a high spring tide level. The whole address formed a valuable contribution to the engineering history of the Mersey Docks.

Engineers' Club of Philadelphia.—Business meeting Nov. 1, 1890. President H. W. Spangler in the chair; 21 members present. The Secretary presented a report from the committee which had been appointed to represent the Club at the convention of representatives of the engineering societies, held in Chicago, with reference to the part the engineers of this country should take in the coming World's Fair in Chicago. The committee outlined the purpose of the congress referred to, its probable cost, and recommended that the Board of Directors report at the next meeting of the Club as to the advisability of taking part therein.

Mr. Benjamin Franklin presented a paper upon the Application of Drain Tiling to the Improvement of Ground for Residences. There was some discussion of this paper. Mr. Howard Murphy noted a case where drain tiling had been used by him around a private residence in order to relieve the flooding and dampness in the cellar. The Secretary presented, for Mr. Harvey Linton, a paper upon Topographical Surveying, with photographic illustrations.—HOWARD MURPHY, Secretary.

Civil Engineers' Club, of Cleveland.—Meeting of Nov. 11; 23 members and 5 visitors present. Prof. H. F. Reid read a paper on "The Muir Glacier." Prof. Reid led an exploring party to Alaska last summer, and in the course of his paper said that this glacier covers an area of 1,000 sq. miles, flows in two opposite directions and has one terminus at tide-water level and another several hundred feet higher. The lower terminus is about 1½ miles wide and rises 250 ft. above the water and extends an unknown depth under the water, sounded to a depth of 1,000 ft. From this terminus immense masses of ice fall into the water continually and float off as icebergs. A remarkable phenomenon exists in the form of a central moraine, extending from end to end of the glacier and moving in two opposite directions and apparently having no beginning. Its like has never been observed before. The velocity of the glacier flow at the lower end was found to be from 8 to 10 ft. per day, and at the upper end from 2 to 3 ft. per day. It is believed that the glacier is receding and permanent stations were established for future reference. Other means were employed to find out whether or not one branch is what is called a "dead glacier." An interesting discussion on glacial phenomena followed the reading of this paper. A. H. PORTER, Sec.

New York Railroad Club.—A meeting was held on Thursday afternoon, Nov. 20, at the Gilsey House, at which 30 members were present. The meeting was called to order by Vice-President R. C. Blackall, and Col. H. G. Prout was chosen Secretary *pro tem.* The committee on constitution and by-laws submitted their report, and the new instruments were read. The regular meetings are to be held at 2 P. M. on the third Thursday of each month. All persons interested in the construction, equipment, and maintenance of railroads are eligible to membership. The annual dues are placed at $2. On motion of Mr. Sinclair the constitution and by-laws were adopted as read. It was also voted to make the salary of the Secretary $600 per annum. The election of officers for the ensuing year then took place, and the whole list of officers was voted for on a "blanket" ballot. The vote for *President* was: Ross Kells, Erie, 16; R. C. Blackall, D. & H. C. Co., 11; for *First Vice-President*, R. C. Blackall had 16; C. W. Bradley, 5; Ross Kells, 3. The remainder of the ticket elected was as follows:

Second Vice-President, W. L. Hoffecker, Central of N. J.; *Third Vice-President*, Frank S. Gannon, S. I. R. T.; *Secretary*, H. G. Prout, *R. R. Gazette*; *Treasurer*, C. A. Smith, Union Tank Line; *Executive Committee*, Jno. S. Lentz, L. V.; Wm. Buchanan, N. Y. C. & H. R.; W. H. Lewis, D., L. & W.; H. S. Hayward, Penn.; Thos. Ald-

corn, West Shore; *Finance Committee*, E. H. Andress, J. H. Bailey, S. W. McMunn.

The secretary was instructed to have 500 copies of the constitution and by laws printed. Treasurer C. A. Smith read his report, which showed cash in the treasury to the amount of $477.49. Adjournment was then taken. The next meeting will be held Dec. 13. The subject for discussion will be announced later.

American Society of Civil Engineers.—The Board of Direction issues the following for the information of members of the society:

In accordance with the provisions of the constitution quoted below, letter ballots will be issued at least 20 days before the annual meeting, which will occur Jan. 21, 1891.

The following report has been received from the Nominating Committee:

PITTSBURGH, Oct. 25, 1890.

To the Board of Direction of the American Society of Civil Engineers, New York City.

GENTLEMEN: I am instructed by the Nominating Committee, appointed at the last annual meeting, to present to the Board of Direction, in accordance with Article VII., paragraph 4, of the constitution, the following names as those selected by them as candidates for officers:

For president, OCTAVE CHANUTE; for vice-presidents, JOHN BOGART, CHARLES HERMANY; for secretary, JOHN C. TRAUTWINE, Jr.; for treasurer, G. S GREENE, Jr.; for directors, THEODORE COOPER, RUDOLPH HERING, CLEMENS HERSCHEL, ED. P. NORTH, S. WHINERY.

Very respectfully, for the Nominating Committee,
CHARLES PAINE, Chairman.

The Board of Direction is of the opinion that Mr. JOHN C. TRAUTWINE, Jr., Assoc. Am. Soc. C. E., is not eligible under the constitution to be the nominee of the Nominating Committee for the office of secretary.

The Board of Direction, for the information of the members of the society, also states that Mr. JOHN BOGART, Mr. G. S. GREENE, Jr., and Mr. THEODORE COOPER, have declined the nominations as made by the Nominating Committee.

Then follow the provisions of the constitution as to nomination and election of officers, Article VII.

American Society of Civil Engineers.—At the meeting on Nov. 19, Vice President Fteley in the chair, the paper read at the last meeting by Dr. Currier, M. D., on "Self Purification of Water, Flowing Water and the Influence of Polluted Water in the Causation of Disease; a Biological Study," was discussed.

Mr. Rafter, in a discussion read by the Secretary, referred to the infusoriæ which inhabit water, and are much larger than the bacteria. There are great numbers of minute animals in water contaminated by sewage; they feed upon the sewage, and while some of it is returned as their excrement, a certain amount is absolutely consumed in the life processes of the animals. Mr. Worthen referred to the value of microscopical investigations. He considered the subject of vital statistics to be the most important one under the care of Boards of Health; better records should be kept in this country, such as are now kept in England. Dr. Leeds thought that a very much larger number of observations than these recorded in the paper should be made before drawing conclusions. Mr. Hering stated that while the paper was an able exposition of work that has been done, there was little in it to help the engineer practically. The Massachusetts State Board of Health is making experiments with filter beds as well as water supply, and the results will be published in the report of the Board in January next. Dr. Currier, in reply to various points raised, said that his paper was merely a record of facts as he had found them, and he had tried to avoid committing himself to any particular theory. Mr. Croes said that while the paper purported to be on the purification of water in streams, only about half of it referred to this subject, and it was unfortunate that there was so much irrelevant matter. As far as it dealt with its main subject it was a valuable paper, and he hoped that Dr. Currier would condense it before publication, so as to bring out more clearly the valuable matter.

The general opinion of members seemed to be that the paper was of too general a character, that the observations were not complete enough, and that the author did not compare or analyze the results to show useful facts.

New England Railroad Club.—At the meeting on Wednesday, Nov. 12, the subject discussed was the economy and safety of swing motion trucks as compared with rigid trucks. The discussion disclosed the fact that the swing motion principle was regarded with general favor, although it was generally acknowledged that many of the swing motion trucks built were very defective in their construction.

Mr. F. D. Adams, of the Boston & Albany, condemned the usual method of constructing hangers by drilling or punching a hole in each end for the axle, which is only 1¼ to 1⅛ ins. in diameter when new, and both axles and hangers wear rapidly by friction. He also mentioned the springing of channel bars in swing beam trucks through the concussions in starting and stopping. He believed, however, if properly built, a swing beam truck would carry the load easier than a rigid truck. Excessive flange wear he considered due to the friction of the side bearings rather than to the type of trucks; and he favored, therefore, the use of some anti-friction device for side bearings. Mr. Marden agreed with Mr. Adams in the main, and thought that swing motion trucks were much better for the freight in the car. They ease the blow when the truck strikes a curve. Nearly all the fruit cars run across the continent have swing trucks and the fruit is found to come in better shape in them than in rigid truck cars.

Mr. Adams referred to the use of swing motion trucks on passenger cars, and said that the improvements he had adopted had increased the life of the swing motion details on these cars over ten times.

The Secretary read a letter from Mr. W. H. H. Sisum, describing a new style of truck, known as the "canting lever" truck, which is in use under stock cars in actual service. Mr. Gordon, of the Concord R. R., said that that company builds nothing but swing motion trucks at present. The hanger used is a link 1¾ × ¾ ins., and the axle is 3 × 1½ ins. In ten years he had never known of an axle breaking. Mr. J. B. Fletcher, of the National Dispatch Co., said that while swing beam trucks cost more to build, they were cheaper in the end, as the reports of shippers and freight handlers showed. All National Dispatch cars have swing beam trucks. Mr. Coughlin instanced the blocking of the bolsters of an extra width passenger car to prevent the swing motion from acting, with the result that at high speeds no man could stay in his seat.

At the next meeting, to be held Dec. 10, the subject for discussion will be, "The Best Form and Application of Brakes to the Driving Wheels of Locomotives."

Association of Civil Engineers of Dallas, Tex.—At the meeting on Nov. 7, President Sherman read a paper on "The Railroad Labor Problem."

Mr. Sherman commenced by referring to some of the great railway strikes as evidence of the differences between capital and labor, and then proceeded to consider how these differences can be brought to a minimum, and how they can be equitably adjusted with the least injury to the commercial world. He considered the great number of employés of a railway company, and the consequent absence of contact between employer and employé, to be the cause of much of the trouble and lack of sympathy between the two elements; while it is under such conditions that the labor agitator can do so much harm. It is desirable to re-establish the harmonious relations, and the problem is how to accomplish it. In the first place the company should establish a scale of wages as liberal as possible, and also assist in providing good homes, schools, churches, etc. But beyond this Mr. Sherman advocated the profit-sharing system as the most promising means for uniting labor and capital. He considered this system to be practicable on a large system of railways. A few examples in this country include the firms of Rand, McNally & Co., of Chicago; Proctor & Gamble, of Cincinnati; N. O. Wilson Mfg. Co., of St. Louis, and Wanamaker & Brown, of Philadelphia. [We believe that H. K. Porter & Co., locomotive builders, of Pittsburg, Pa., have introduced this system.] In France it has been in operation on the Paris & Orleans Ry. for 21 years, during which period an aggregate sum of about $14,000,000 has been divided among the employés over and above the regular wages; in one year, 1883, the salaries of employés were increased an average of 41%, as their share in the profits of the year. The author would have laws passed providing for a system of arbitration, and would make it a penal offence to organize a strike. Resignations and discharges should not be interfered with, but reasonable notice should be required.

In the discussion Mr. Liversedge showed the difficulty of introducing the "profit-sharing" system of wages on railways in America, where a large percentage of railway employés are a nomadic and shifting class, and the system, although offering larger returns for the labor expended, had but little attraction for any but men of steady habits and continuous toil. The percentages of wages could not be conveniently computed at short intervals, and faithful and continuous service would be requisite to the attainment of the advantages in consequence.

Mr. Papier claimed that the incentive to faithful and contented efforts to subserve the interests of the road was the feature of the system, and while many would lose their increase of wages by leaving the employ of the road after short service, yet the system if pursued would gradually improve the class of men employed in each branch of work, until finally the interest and endeavor of each employé would equal that of the officers of the road; and in addition to the benefits received in increased wages, the moral tone among the employés would be elevated to such an extent that "walking-bosses" and "strikers" would have to look elsewhere for sympathy.

The Institution of Mechanical Engineers—(*From our London Correspondent*).—The last meeting of the year was held in London Oct. 29 and 30, and the papers discussed were by M. R. Jefferds on "Tube Frame Wagons of Light Weight and Large Capacity and their Effect on the Working Expenses of Railways;" with one by Geo. Addy, of Sheffield, on "Milling Cutters." Mr. Jefferds has been working many months to secure the adoption on English railways of a type of car similar to the iron tube cars built in the United States by the Iron Car Co. A detail of the construction of these cars which greatly interested the audience was the malleable castings at the joints. The use of cast or malleable iron for important working parts is a feature of American practice at which English engineers look with surprise. A good part of the paper was devoted to a comparison of the merits of English and American "goods wagons."

It has long been known in England that freight is carried much more cheaply in America than here; but this has been ascribed to rate wars, and it has been supposed to be merely a temporary condition of affairs. Mr. Jefferds stated, however, that the high freight rates of England are due to the use of short four-wheel trucks, while in America long double-bogie cars are used to carry freight. The average freight rate per ton mile in the United States is 0.488d. ($0.00976) and the average cost to the railways per ton mile is only 0.311d. ($0.00622). On the other hand the London & Northwestern Ry. charges 1.25d. ($0.025) per ton mile and the cost of carriage to the company is 0.65d. ($0.013) per ton mile. The total average earnings per locomotive per annum on American railways in 1889 was £6,500 ($31,895). The corresponding figures for the United Kingdom were £4,837 ($23,411).

The English engineers and railway men who discussed the paper were, with one or two exceptions, opposed to the reform which Mr. Jefferds proposed, but nothing was brought forward which materially affected the soundness of his position. The chief argument advanced was that cars of 20 to 40 tons capacity might do for American railways where great amounts of bulk freight has to be hauled over long distances, but for the English goods traffic, where the haul is short and the freight requires rapid delivery the smaller capacity cars are superior. As one of the speakers aptly put it: "We are in the retail way; the Americans do a wholesale trade." It was further argued that the long cars with central buffers advocated by Mr. Jefferds could not be run in the same train with the ordinary trucks having side buffers.

In reply to this it was said that the mineral traffic of England is 72% of the whole freight traffic, and for handling this heavy bulk freight special trains could be made up of the new rolling stock. But even for this the expense of the necessary changes in turntables, weighing scales, switches, detector bars, coal tips, hydraulic lifts, etc., would be enormous, and while considerable trial has been made of the new rolling stock, the day when it will come into general use seems still very far in the future. English railway men must first be convinced that the high cost of their freight traffic, as compared with America, is not a result of other things than the type of freight cars used; and if it is in large degree due to the short length of the average haul, it is, of course, a permanent condition which cannot be bettered.

MILLING CUTTERS.

Mr. Addy's paper described an adjustable disk milling cutter with face and edge teeth. Solid disk milling cutters become reduced in size as the teeth wear down by sharpening. To avoid this, milling cutters have been made consisting of two disks, which can be separated from each other to cut slots of varying width, leaving, however, a fin of metal along the center of the groove, which had to be removed afterward. In the cutter described by Mr. Addy, the formation of this fin is avoided by the use of two disks having their adjacent faces in a plane oblique to the axis of the cutter spindle. By this means a single tool may be set to cut grooves varying from 1⅛ ins. to 2 ins. without leaving a fin.

A rule for the pitch of the teeth of cutters which Mr. ADDY has found to work well in practice with cutters from 4 ins. to 15 ins. in diameter is:

$$\text{Pitch in ins.} = \sqrt{\text{Diameter in ins.} \times 8 \times 0.0625}.$$

For the speed of cutters 6 ins. in diameter and larger, where no great depth of material is cut away, he gave the following:

Steel, 36 ft. per minute, with a feed of ⅛ in. per minute.

Wrought iron, 48 ft. per minute, with a feed of 1 in. per minute.

Cast iron, 60 ft. per minute, with a feed of 1⅛ ins. per minute.

Brass, 120 ft. per minute, with a feed of 2⅜ ins. per minute.

Analyses of two Sheffield steels used by the author for milling cutters are as follows:

	Crucible cast steel, per cent.	Self-hardening steel, per cent.
Carbon	1.2	1.67
Silicon	0.112	0.252
Phosphorus	0.018	0.051
Manganese	0.36	2.557
Sulphur	0.02	0.01
Tungsten	....	4.65
Iron, by difference	98.29	90.81
	100.000	100.000

In discussing this point Mr. Holderness, of the Great Eastern Ry., described his difficulties in making large cutters 14 ins. diameter × 6 ins. width from fine steel, as they would break in hardening. For this reason, and because of the saving in expense, he has adopted the plan of making these large cutters from old Bessemer steel car axles, forged into shape and case-hardened by dipping in prussiate of potash. Mr. Addy contended, however, that the best steel was the cheapest.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, November 22, 1890

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST..... .....BUSINESS MANAGER

SUBSCRIPTIONS.

To United States, Canada, and Mexico.

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Advertising rates. 20 cents per line *agate measure. Schedule sent on request.* **Changes** *of advertisements must be in hand on Tuesday afternoon:* **New** *advertisements Wednesday afternoon;* **Transient** *advertisements not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*

COMING TECHNICAL MEETINGS.

Denver Society of Civil Engineers.—Next meeting, Nov. 24. Secy., Geo. H. Angell.

Civil Engineers' Society of St. Paul.—Next meeting, Dec. 1. Secy., G. L. Wilson.

American Society of Civil Engineers.—Next meeting, Dec. 3. Secy., John Bogart, 127 E. 23d St., New York.

Engineers' Club of St. Louis.—Next meeting, Dec. 3. Secy., W. H. Bryan, 30 South 7th St.

Civil Engineers' Association of Kansas.—Next meeting, Dec. 3. Secy., J. C. Herring, Wichita, Kan.

Technical Society of the Pacific Coast.—Next meeting Dec. 5. Secy., O. von Geldern, 408 California St., San Francisco.

Association of Civil Engineers of Dallas.—Next meeting, Dec. 5. Secy., E. K. Smoot, Elm and Austin Sts.

Engineers' Club of Philadelphia.—Next meeting, Dec. 6. Secy., Howard Murphy, 1122 Girard St.

Civil Engineers' Club of Cleveland.—Next meeting, Dec. 9. Secy., A. H. Porter, 50 Euclid Ave.

Western Society of Engineers.—Next meeting, Dec. 9. Secy., J. W. Weston, 280 La Salle St., Chicago.

New England Railroad Club.—Next meeting, Dec. 10. Secy., F. M. Curtis.

Engineering Association of the Southwest.—Next meeting, Dec. 11. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Western Railway Club.—Next meeting, Dec. 16. Rooms, Phenix Building, Chicago. Secy., W. D. Crosman, 816 Rookery, Bldg.

Engineers' Society of Western Pennsylvania.—Next meeting, Dec. 16. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, Dec. 17. Secy., S. E. Tinkham.

New York Railway Club.—Next meeting, Dec. 18. Rooms, 118 Liberty St.

Engineers' Club of Cincinnati.—Next meeting, Dec. 16. Secy., J. F. Wilson.

As some of our readers may prefer a legal opinion to our common sense view of the constitutional questions, discussed in a following editorial, we may say that we have obtained such legal opinion and subjoin the result. The opinion is given by a well known corporation lawyer of this city, and it should settle the question of the eligibility of Mr. TRAUTWINE for the office of Secretary; especially, as we learn, on inquiry, that the contrary opinion of the Board of Direction was not based upon legal advice, but upon their individual judgment.

LAW OFFICE OF JAMES W. HAWES,
140 NASSAU ST., New York, Nov. 20, 1890.

TO THE ENGINEERING NEWS PUBLISHING CO.

My opinion has been asked respecting the eligibility for the Secretaryship of the American Society of Civil Engineers of JOHN C. TRAUTWINE, JR., a non-resident Associate.

My attention has been directed to the Constitution of the Society, and especially to Article *II*, Sec. 2; Article *III.*, Sec. 9; Article *IV.*, Sec. 1; Article *VI.*, Sec. 1, and Article *VII.*, Secs. 4 and 5.

After considering these provisions, and referring to judicial decisions on analogous subjects, I am of the opinion that the weight of reason and authority favors the eligibility to office of an Associate or Junior, with all the powers belonging to the particular office. I am similarly of the opinion that it is sufficient that the Secretary should be a resident at the time of assuming the office.

I find no authority vested in the Board of Direction to decide upon the eligibility of candidates for office.

JAMES W. HAWES.

THE London *Financial News* sits down hard upon the Irish Channel tunnel project noticed in the present issue. Admitting that this tunnel could be built and has one great advantage over the much discussed English Channel tunnel, in that no one will fear invasion from Irish soil, the *News* yet thinks Ireland and its commerce is hardly large enough to warrant the expenditure of the $40,000,000 that it is estimated it will cost. The objections are that no revenue could be expected from the large investment made during the 12 years it would take to build it, and it will for this reason be difficult to raise the money. An ordinary railway would have to earn in gross $4,000,000 per annum to pay 5 per cent. on the capital stated, allowing 50 per cent. for working expenses. But this tunnel is by no means an ordinary railway, for pumping and ventilation must be provided for on an excessive scale. It costs 1,000 tons of coal to pump the 500,000,000 gals. of water which leak into the Severn tunnel in 30 days; and the Mersey Tunnel Co. pays 20 per cent. of its gross revenue for pumping and ventilating.

Assuming that it need earn only $125.000 per mile of tunnel to pay 5 per cent. the *News* finds that in 1889, the most prosperous year ever known, the average earnings of the railways of the United Kingdom were only $22,500 per mile per annum; and in Ireland alone the average was less than one-fourth of this. But as the proposed line would really be a grand trunk line connecting important cities, it could be compared with other exceptional lines in England. The Manchester, Sheffield and Lincolnshire and the Lancashire and Yorkshire railways stand among the great companies for receipts per mile, and these earn about $35,000 and $40,000 respectively. Of short local lines the Metropolitan of London earns $90,000 and the District Railway about $105,000 per mile per year. The short Mersey Tunnel railway earns $70,000 per mile. The one line that surpasses all others in earning power is the North London, every foot of which line is crowded with traffic in every hour of every day of the year. This road earns about $200,000 per mile per annum. But the *News*, naturally, thinks it absurd to compare this London local line with one that has to run 33 miles before it can pick up another passenger or an extra ounce of freight. The tunnel promoters must face the problem of either running counter to all precedent and put the rates for a long railway journey down to the level of a shorter water route, in which case they will reduce their profits to the vanishing point; or they must keep up their rates to a standard that will yield reasonable returns and lose the traffic altogether, for that will prefer the present shorter and much cheaper transit by steamer. The *News* thus makes out a bad case financially for the projected tunnel under the Irish Channel, and teaches its engineer that there are other important elements to be considered, in discussing such an enterprise, besides the mere engineering features of the problem.

THE Board of Experts which is considering the problem of enlarged traffic facilities for the New York and Brooklyn Bridge has the subject still under consideration, and when they will be prepared to report, or what their report will be, is still unknown. In the meantime, any discussion of the problem itself would be superfluous and improper; but the following picture of the state of things which the Board is to alleviate has a certain interest. It appeared in the New York *World* of Nov. 10, and every patron of the bridge transit facilities can testify that it is in no respect overdrawn:

No person who habitually crosses the East River Bridge during the crowded hours of the evening can have failed to observe that the crowding grows steadily and rapidly worse. The increase in the number of passengers is natural and cannot be helped, but the increasing rudeness and brutality of the struggle for early entrance to the cars for the sake of seats is wilful misconduct, without palliation or excuse.

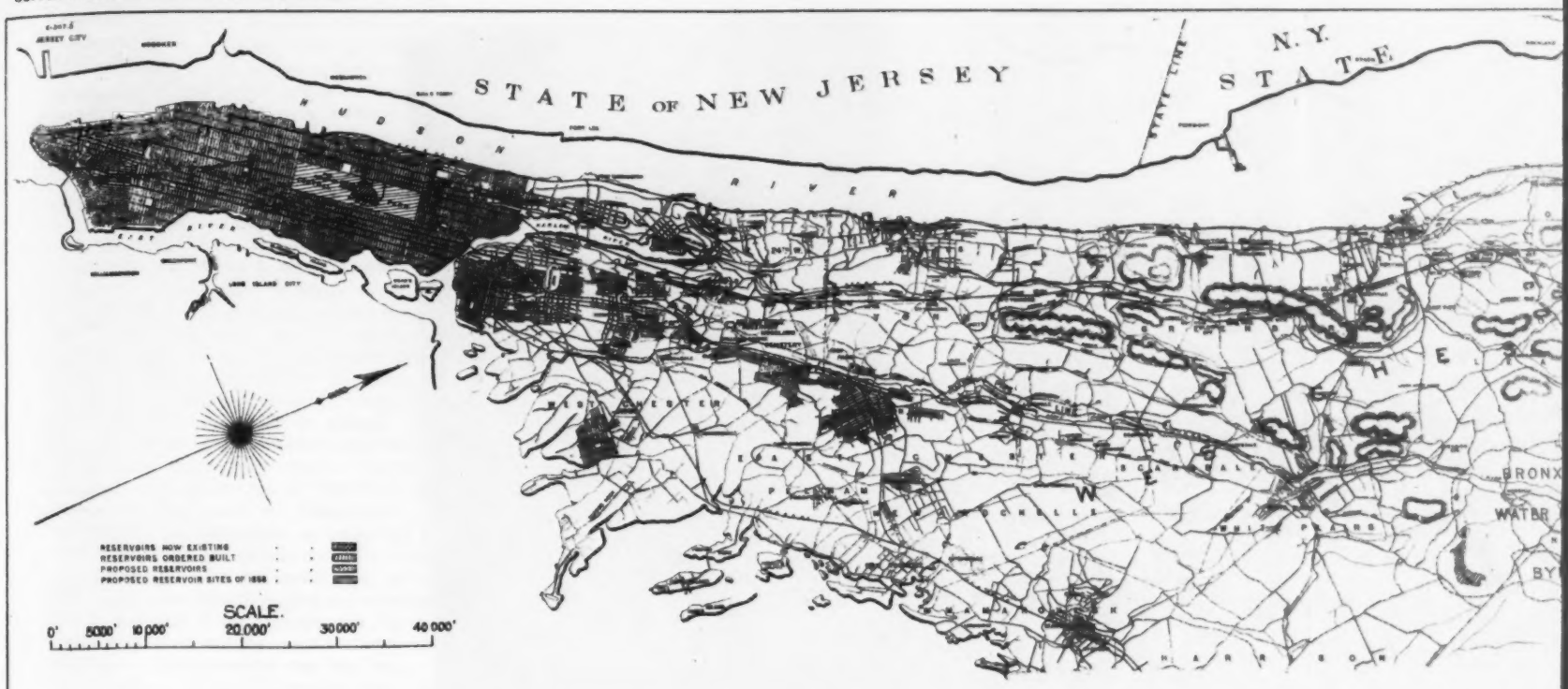
It is a fight—almost a slugging match. Delicate women are not only hustled but dangerously crushed between masses of struggling men. Often they are pressed mercilessly against the iron rails of the cars until their bones and even their lives are in danger. In the very midst of this struggle the gong sounds and the train moves out, *tearing the crowd into two fragments, the one on the cars and the other on the platform.*

This crowding is brutal, indecent and dangerous to human life. It is prompted by a well-nigh incredible selfishness, its sole object being to secure seats for a brief ride of six minutes. Obviously something must be done to remedy the evil before it results in disaster, as it threatens to do. The French system of passing passengers in single files through railed queues might afford some relief if the platforms were large enough to admit of its application, but they are not. If the cars could be provided with transverse seats, facing each other, with an entrance between each pair, some gain would be made, but not much. *The entire removal of the seats which are the primary cause of the struggle may become necessary,* but even that will hardly cure the habit already formed. Something may be done if those who are not obliged to cross at the precise time of the crush will recognize the fact that the bridge is overtaxed, and take a little pains to cross a trifle earlier or later. If nothing is done, disaster is inevitable.

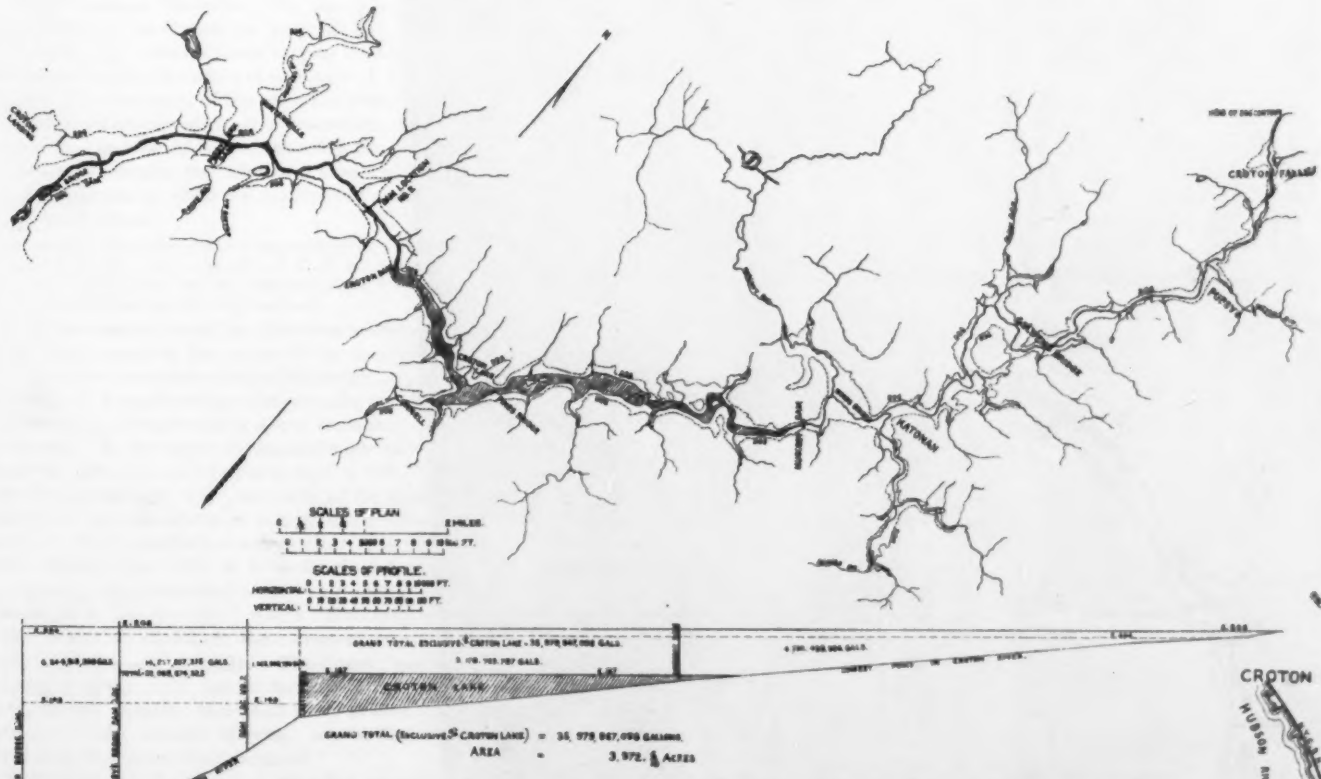
The "entire removal of the seats," as suggested in the italicized sentence above, is indeed the next step logically if present conditions are to continue. The comfort of the average passenger would be promoted by doing it at once; but what a confession of inability to carry men more comfortably than cattle would thus be made. The "French system" of passengers in single file would not permit the necessary number to enter in the available time. The suggested transverse seats with side openings would greatly diminish capacity. The crowding, "brutal, indecent and dangerous," as it undoubtedly is, is not due so much to "incredible selfishness" as to entirely natural devil-may-carelessness on the part of the stronger, and to the terrifying aggregate of pressure which arises from very slight additions by each individual of a crowd. There is no possible remedy for this crowding but large additions to both the platform and car space.

A LINE of railway connecting America and Asia, via Alaska and Behring Straits, is a favorite topic for newspaper discussion, and ex-Governor GILPIN, of Colorado, is even now pushing such a scheme. Aside from all commercial profit to be gained, which is in itself very doubtful, there are engineering considerations that the projectors seem to neglect in their alleged study of the subject. Mr. GILPIN says it is easy to bridge the Straits, as an island lies midway between, the distance is not great and the water is shallow. But the government charts say that the greatest depths is 192 ft.; and as the piers of a bridge at this point must be made to stand the shock of icebergs and ice-floes of almost any volume moving with the force incident to a narrow channel and swift current, the chances of their survival can be better guessed at than estimated.

The channel could doubtless be tunneled, if expense were to be disregarded, but there are other and more serious troubles in the way. The country is exceedingly rough and mountainous on both the Alaskan and Asiatic sides. Along the Alaskan coast line the mountains come to the sea with a sheer face of hundreds of feet in many places, and run back to altitudes touching 16,000 ft. and more. This coast line is cut by deep and narrow cañons, some of them navigable by large ships, and these must be crossed, and at other points mighty glaciers flow into the sea. Of the possibilities of an interior line nothing is yet known; but with even a fair and rolling country fit for railroad building, these high latitudes present still another seriousdifficulty. We have the authority of Mr. IRCHEVICK-KONDRATOVITSH, the Assistant Chief Engineer of the proposed Siberian Ry., and lately in this country, that at points on that line frost-bound ground



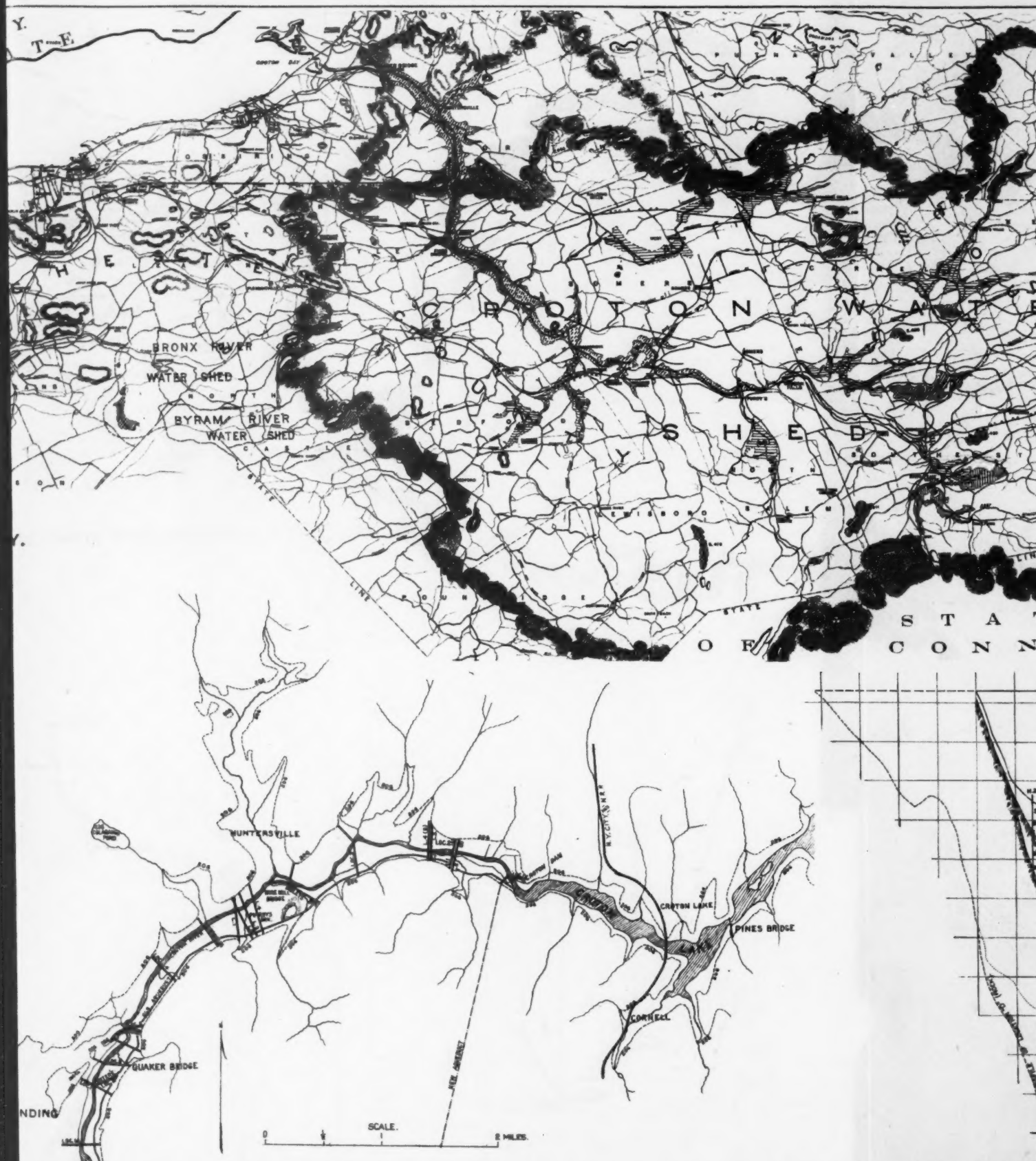
GENERAL PLAN OF WATERSHEDS SUPPLYING NEW YORK CITY.



PLAN AND PROFILE SHOWING LOCATION AND CAPACITY OF PROPOSED MAIN RESERVOIR COMPARED WITH PRESENT RESERVOIR.

NEW YORK

RECENT INVESTIGATIONS



PLAN SHOWING PORTION OF CROTON VALLEY TESTED BY DIAMOND-DRILL FOR FOUNDATIONS OF PROPOSED MAIN DAM.

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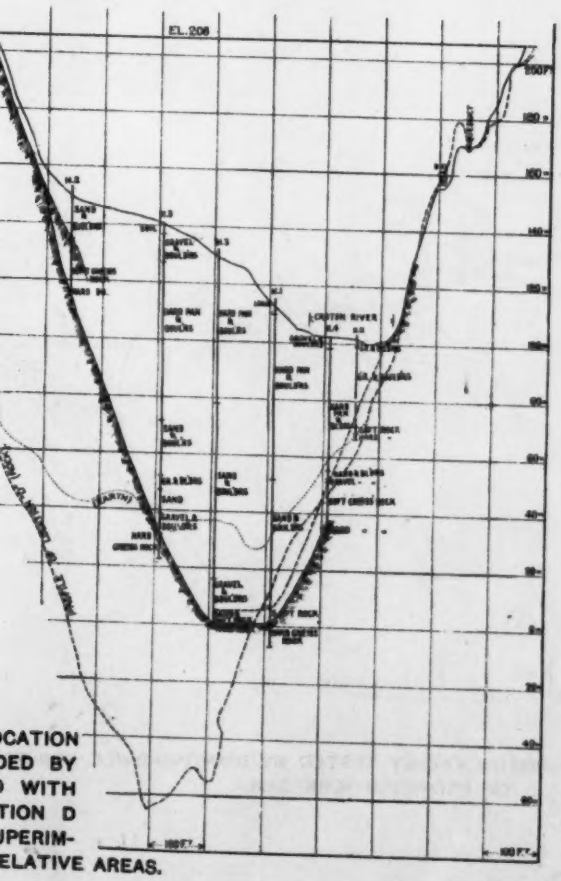
New York City Water Supply.

Investigations into the site of the proposed main dam.

A. Fteley, Chief Engineer.



OCATION
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UPERIM-
ELATIVE AREAS.

CHAS. HART & SONS, LITH., 88 VESEY ST., N.Y.

presents a serious problem to the railway builder. In these countries the ground is frozen to a depth of 40 or 50 ft., and if it would remain so it would be all right for supporting a roadbed. But it does not remain so; in the short, hot summer the surface thaws out for 10 ft. or even more, and is transformed into a semi-quagmire that will neither support the ties nor rails. Pile driving would be only possible in summer, expensive and, at the best, of doubtful value in providing the necessary foundation. If this be so along the Siberian line, what may be expected in lands as far north as Behring Straits, lying almost on the Arctic Circle. But even supposing that a railway were possible, from an engineering standpoint, what useful purpose would it serve? The distance from Vancouver to Behring Straits is, roughly speaking, about 1,800 miles, and to connect with the Russian line at Vladivostock would require the building of 2,400 miles more. Commercially speaking, the construction of over 4,000 miles of railway through such an inhospitable country would never pay for freight or passenger traffic, and building at the Asiatic end would seem especially absurd and impossible. A railway to Sitka may some time be needed and when the demand warrants it an attempt will doubtless be made to build it; but the world at large will for a long time to come prefer fast and large steamers as a means of transit between Asia and the west coast of North America.

A Constitutional Question.

We reprint in another column a circular from the Board of Direction of the American Society of Civil Engineers, which we need hardly say is of a somewhat unusual character. For the first time in the history of the Society an Associate has been nominated, in the constitutional way by the constitutional agency for the office of secretary. For the first time also the Board of Direction has interfered with the usual course of such nominations—submission to the vote of the membership for their judgment—by issuing the following brief and unqualified opinion, in which we italicize one curious interpolated phrase:

> The Board of Direction is of the opinion that Mr. JOHN C. TRAUTWINE, JR., Assoc. Am. Soc. C. E., is not eligible under the Constitution *to be the nominee of the Nominating Committee* for the office of Secretary.

It will be observed that the italicized words are not at all necessary to the sense of the sentence, and they must have been inserted, therefore, either carelessly or in explanation or defense of a purpose to leave off Mr. TRAUTWINE'S name from the official ticket. If the latter, we earnestly advise the Board to take no such extreme step; it will certainly be resented by the great body of the membership as an unauthorized and unlawful interference. The constitution is very clear upon this point. Under Art. VII. it is declared that the nominating committee shall consist of "members not officers of the Society," which "shall present to the Board of Direction the names of persons selected *by them* as candidates. The Board "*shall* thereupon cause such list to be posted in the rooms of the Society, and *shall* issue, at least 20 days before the Annual Meeting, a letter ballot *containing the names thus proposed.*"

It is doubtful if the Board of Direction, as such, can constitutionally interfere with the nominations for officers in any manner, even to the extent of expressing opinions on the qualifications of nominees to succeed themselves in office. They certainly have no authority to change the ticket as reported to them, by omission or otherwise, and propriety would seem to indicate that any such statement should only be ventured when the case was very clear, and that it should even then be accompanied by reasons, so that the final judges, the voting members, could decide the matter for themselves. As they do express an opinion, and do not give any reasons for it, however, we will endeavor to summarize the arguments both for and against the position they have assumed.

The arguments pro and con may be summarized as follows, beginning with those which make against the eligibility of an Associate for office:

The ground for objection is expressly stated to lie in the constitution, and by implication in Art. VII., sec. 4. The laws of the State of New York under which the Society is organized merely state that the original incorporators "and their associate and successors" may "annually elect from its members its trustees, directors or managers in such manner as may be specified in its by-laws." The grade of Associate being expressly declared in Art. II., Sec. 2, of the constitution to be one of three grades into which "the active members" are divided, there can be no question that an Associate is eligible so far as the law is concerned, if not elsewhere in the constitution declared ineligible.

In Art. VII., Sec. 4, of the constitution, however, it is declared that "of the candidates for officers at least one vice-president, three directors, the secretary and the treasurer shall be *Resident Members.*" It may be claimed (1) that a man living in Philadelphia when nominated is not a Resident, and (2) that an Associate is not a Member. Moreover, as to Art. II., Sec. 2, which appears to contradict this view, and reads as follows:

> The Active Members of the Society shall be divided into three classes, to be styled, respectively, Members, Associates and Juniors. Associates and Juniors shall possess all the rights and privileges of Members, excepting the right of voting.

It may be claimed as to this that the denial of the right of voting carries by implication the denial of the right to hold office, and extends to denial of the right to vote as an elected officer as well as the right to vote as a junior or associated member.

It may be claimed also that in cases of doubt as to the interpretation of any law past practice under it is the proper guide, and that never before has an Associate or Junior been nominated or elected for office, establishing the presumption that it was not intended that they should hold office.

This, we believe, is the full case against the eligibility of an Associate for office, as fully and forcibly stated as its nature permits. We will now state the case in favor of his eligibility:

It is an established and ancient legal principle that every law tending to abridge the privileges or immunities of an individual or of a class must be construed strictly; that no man's privileges can be abridged by implication, unless the words or the intent be plain; that he is entitled to every benefit of a reasonable doubt.

Art. II., Sec. 2, as above quoted, if construed literally, explicitly confers upon Associates or Juniors the right to hold any office to which they may be elected. The right to vote and the right to hold office are distinct things; in every part of the world thousands may vote who may not hold certain offices; thousands may be elected to office who for change of residence or other cause may not vote.

Is the implication and intent different from the letter of this article? This depends largely upon probable motive. There is no motive for excluding the junior grades of members from office if chosen by the voters. There is a motive for denying them the right to vote; to place the control of the Society in the hands of the older and more eminent members only. But if the latter, in their discretion, decide that the interests of the Society will be promoted by placing an Associate or Junior in a certain office, even if it be President of the Society, who is to say them nay? There is a broad distinction between allowing voting members to place an Associate in office, if they wish to, and leaving it possible for voting Associates and Juniors to do the same thing against the will of the senior grade.

The constitutional qualification for Associate, so far from appearing to disqualify for office, makes him particularly eligible for such offices as Secretary or Treasurer. He must be a manager or proprietor of some manufactory or public work, a scientist or architect, or one who "from his scientific acquirements or practical experience has attained eminence in his special pursuit, qualifying him to co-operate with engineers in the advancement of professional knowledge, *but shall not himself be practicing as an engineer.*" The last clause makes an Associate particularly desirable for Secretary. It is much better that the Secretary should not be himself practicing as an engineer, for obvious reasons.

Again, the constitution as it was till lately codified said absolutely nothing as to the Secretary or any other officer belonging to any particular grade of membership. Had it been deemed desirable to so limit the privileges of the associate and junior grade it would presumably have been so stated. It was not so stated nor implied. Art. VII., Sec. 4, of the codified constitution, which declares that the Secretary, etc., shall be "resident members," was until lately a by-law only (Section 24, 4th), and as a by-law could add nothing to the provisions of the constitution, but merely expound or supplement them. As the codification was officially laid before the members as changing nothing, but merely combining the two instruments preparatory to a general revision, this clause has no more force now than it had as a by-law. It was not intended to add anything to the older provisions of the constitution, and must be so construed.* But it is in fact the only clause which even implies that an Associate is ineligible to office.

It is denied, however, that this clause, even as it stands, has the effect to disqualify an Associate for certain offices by declaring that they must be held by "resident members." The word "member" is used in a double sense throughout the constitution; first, in the broad sense, to include the three grades of active members specified in Art. II., Sec. 2, quoted above; secondly, in the narrow sense of designating one grade of membership only. The plain intent of Art. VII., Sec. 4, was merely to require that certain of the officers should be resident, and not that they should belong to a particular grade, the word "member" being added only in the broad sense of Art. II., where it is declared that the "active members" shall be divided into three classes. This presumption is strengthened by the fact that in numerous other cases throughout the constitution, among which are the following, the word "member" is used in this broad sense to include all grades of membership:

> ART. III., SEC. 10. *Every person admitted to the Society* [if his dues are not paid, etc.] shall cease to be a *Member.*
>
> ART. III., SEC. 12. Upon written request . . . that *a person belonging to the Society* be expelled . . . the Board of Direction will notify the *Member.* In case no appeal is made the Board of Direction will expel the *Member.*
>
> ART. IV., SEC. 1. *Members* who become Residents or Non-Residents by removal . . . shall be subject to assessments in the class in which they were residing, etc.
>
> ART. IV., SEC. 3. It shall be the duty of the Secretary to notify each *Member* of the amount due for the ensuing year.
>
> ART. IV., SEC. 4. Persons who shall be elected *Members* after six months of any year shall have expired [shall pay only one-half of the annual dues.]
>
> ART. VI., SEC. 5. A book shall be kept in which *Members* may enter the title of any book which they may wish to have added to the library.
>
> ART. VI., SEC. 8. [The Library Committee in examining papers for publication may] call to their aid one or more

*The committee used the following explicit language in their report of Nov. 1, submitting their proposed codification for ballot:

"This codification contains only verbal amendments to the present constitution, in which provisions relating to the same subject are scattered miscellaneously, some of them being in the constitution and some in the by-laws. In this codification no change whatever is made in the sense or meaning of the constitution and by-laws. The articles are simply grouped together. Members will understand that in voting upon this codification they are not voting upon any amendment of the constitution and by-laws, excepting only in form, but they are voting for an arrangement of the present constitution and by-laws made to enable the work of the committee to be passed upon intelligently hereafter."

Members of special experience relating to the subject treated.

ART. VIII., SEC. 6. Candidates for *Membership* to be balloted for. Communications from *Members* to be read. [N. B. Any person connected with the Society, whether or not he has the right to vote, has the undoubted right to present communications and make motions.]

In the regulations as to Fees, Dues, etc., p. 17, of last "List of Members":

Persons elected *Members* after six months of any year have expired pay only one-half, etc.

In the Code of Rules for Awarding the Norman Medal:

I. Competition *shall be restricted to Members* of the Society [which immediately after is explained to mean]:

III. All papers presented by *Members of any class* shall be open to the award.

In the Abbreviations for Designating Membership the Board of Direction itself has declared the following as:

Authorized abbreviations to be used by *Members of the Society* having occasion to designate themselves as such: M. Am. Soc. C. E.; *Assoc.* Am. Soc. C. E.; *Jun.* Am. Soc. C. E.; F. Am. Soc. C. E.

In Art. II., Sec. 3, Art. III., Secs. 1, 7, 8, 9, and elsewhere, the word "membership" is thus broadly used.

These quotations establish that the word "member" is frequently used throughout the constitution in the broad sense to include all grades of membership. Who, then, has a right to gratuitously assume that it was intended to be used in a narrow sense only in Art. VII., Sec. 4? The very history of the clause, a mere transference from a by-law which could not lawfully have such sense, makes such interpretation impossible as well as forced.

Furthermore, the denial to certain grades of the right to vote as members of that grade does not even by implication deny the right to vote as an elected officer and trustee, if duly chosen such, but rather the contrary. Even if it did, the officer would stand merely in the position of a delegate to Congress, and could still discharge every proper function of a secretary. The less the secretary interferes with the general management of the society the better.

Finally, and more than all else, dubious constitutional quibbles based upon the present constitution are particularly gratuitous, because there is now in the hands of the Board of Direction a report from the Committee on Revision of the Constitution, containing a revised form which will undoubtedly be adopted in its substance within a few weeks, and under this the Secretary becomes merely an appointed agent or executive officer of the Board of Direction to be appointed at their discretion and hold office at their pleasure.

If, therefore, an Associate is not at this moment eligible as Secretary, he will become so almost as soon as elected, making it particularly unreasonable to object to a candidate upon constitutional grounds, which have little to support them to begin with, and will soon have nothing at all.

Such is the argument in favor of the eligibility of an Associate for the office of Secretary, or of any other to which he may be nominated and elected. It appears to us conclusive. It appears to us that the Board of Direction have placed themselves in a false position by expressing an opinion which may be plausibly claimed to be neither good law nor good sense upon a matter which is not intrusted to them by the constitution for good and evident reasons.

CORRESPONDENCE.

The Am. Soc. C. E. Nominations.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In common with all the members of the American Society of Civil Engineers, I suppose, I have received a circular from the Board of Directors which has rather surprised me. I believe that the directors have violated the Constitution of the Society, Article 7, Section 5. They are required merely to issue the list of nominees, and they are not required to give an opinion as to the eligibility or desirability of any of the candidates. It is well enough to inform the members that certain nominees decline the nominations, but that is as far as they can go. Besides, the opinion of the Board of Directors is of no more account than that of any other number of laymen, whether members or not, and I think they have arrogated to themselves a function in violation of the constitution by advising members as to the eligibility of the nominees. I hope that some one will obtain an authoritative legal opinion on the question raised by the directors. Further, it would be proper at this time, for some one to present to the members in a circular the following facts as to the past management of the society: The secretary's salary; the salary list of other employees; the fact that the secretary has a free residence at the company's house in New York, if he has one; these and other like facts are not known to a great majority of members. I, myself do not know what the salary of the secretary is, and the matter has been treated as too much of a mystery. I think the members are entitled to the fullest information on these points, and they ought to be brought out now so that members can vote intelligently. Further, I would be glad to know if it is true that the present secretary holds several different salaried positions, so that he is in the curious position of holding on to a salaried office to which he can devote no time at all if he properly looks after the duties of his other positions. I have heard it asserted, on the other hand, that the secretary is paying some of the employees out of his own salary." Is this a fact? Members should know it. By an impartial discussion of these facts, so necessary for every member to know, I believe the new secretary will be elected if the facts are as I understand them; otherwise, he will be defeated. M. AM. SOC. C. E.

The Am. Soc. C. E. Secretaryship.

NEW YORK, Nov. 18, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR—Referring to the circular of the Board of Direction questioning the legality of the nomination of an Associate Member as Secretary of the Am. Soc. C. E., and to some other matters connected with the welfare of the society, I would like to ask the following questions:

Is not, in this and kindred societies, the will of the membership the law of the society, both in expression and interpretation? Under this valid assumption, is not the opinion of the Board of Direction, without specific statement of reasons, somewhat gratuitous?

If an Associate were not eligible to office of trust, would not the constitution have plainly said so, as is the practice in other societies under similar circumstances? Does not the constitution explicitly give the Associate and Junior "*all* the rights and privileges of Members, except ing the right of voting"? What are these "rights and privileges" of Members (with a capital M in the constitution) if they do not include the office in question?

Does not the list of Associates of the Am. Soc. C. E. contain at least half a dozen of the most eligible men in the Society for the office of Secretary, in addition to Mr. TRAUTWINE? Men like Professor BEARDSLEY, of Swarthmore College; Professor COMPTON, of the College of the City of New York; Professors FLETCHER and HAZEN, of Dartmouth College; Professor HOWE, of the Rose Polytechnic Institute; Professor SWAIN, of the Massachusetts Institute of Technology, etc.? Was it the will or intent of the members who originally framed the constitution to exclude men of this stamp from the most important office in the Society, men with acquirements specially fitting them for this office?

Is the present secretary taking an active part in an attempt to retain himself in office, against the judgment of a nominating committee appointed by the whole membership?

Is it possible for any secretary to perform his full duty to the society, and yet hold other important offices and actively practice the profession of engineering?

Why is there such a paucity of really good practical papers read before the society? An active secretary, who has the time to devote to the interests of the society, should certainly be able to gather from the wide practice of this country ample and creditable material.

Are our publications conducted in a business-like manner? They are edited by the secretary and I believe he has the conduct of affairs. Yet I find that, with a membership of 1,289, the publication of 1,079 pages in 1889 cost $12,734.64. I also find that the American Society of Mechanical Engineers, with 858 members, published in the same year 1,032 larger pages for $2,739.33 for "printing transactions and pamphlets," and $1,003.92 for "engraving"; or $3,743.25 in all. Why is there this difference in cost in practically the same work?

Finally, is not the Am. Soc. C. E. suffering from a case of "dry-rot," brought about by, perhaps unavoidable, neglect under the present lack of system, to push its interests to the fullest extent, and for the good of the society alone?

Other questions of a more personal character might be put, but for the present I would like to hear from the above, as sufficient in themselves to furnish food for thought among the members. M. A. S. C. E.

[The above queries are pertinent, but in the present status of the matter we would prefer that each member of the society answered them for himself. We have editorially expressed our opinion on the question of the legality of the nomination of an Associate Member for the office of secretary.—ED. ENG. NEWS.]

The Worcester Sewage Disposal.

WORCESTER, Mass., Nov. 17, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your article describing the sewage disposal works at Worcester there are several things that need correction, and first as to the cost of the works. The outfall sewer cost $75,000; the precipitation tanks, $40,000, including grading, while the buildings and machinery cost about $8,000; making a total cost of $123,000, instead of $78,000, as stated in the article. Another correction that I wish to make is the often misquoted remark of Prof. SEDGEWICK at a meeting of the Boards of Health of Massachusetts in this city. He spoke of the effluent as being a very fine one, and as far as a person could judge by appearances, everything that would tend to create trouble in the river below the city is removed, and that it was *possible* that it could be drunk with impunity. This remark was misquoted in the daily papers the next day, and I have seen several articles since, published in papers in different sections of the country, in which the reader is given to understand that drinking water is manufactured from sewage at Worcester.

It is true that the effluent produced at our works is perfectly clear, without color, and odorless. It has every appearance of being absolutely pure, but for any one to suppose for an instant that Professor SEDGEWICK meant, or that we claim, that drinking water is produced, is a great mistake. I have had many visitors at the works who have insisted on drinking a glass of this water, and so far as I know they have never experienced any ill effects from so doing. I have never tasted it myself, and we always advised others not to. I have made a careful study of this question for eight years and I do not believe we have sufficient light upon the subject yet to warrant recommending that the effluent from irrigation, downward intermittent filtration or chemical precipitation works be turned into streams used for water supply purposes. It is quite possible, however, to produce an effluent by either of the above methods, of sufficient purity to turn into streams not so used, without creating a nuisance, or in fact, so far as appearances go, without changing the character of the stream in the least.

There is one more correction which I wish to make. In Fig. 8 the side walls should be shown as brick instead of cement. In Fig. 6 the foundation walls to the steps should be shown of rubble masonry instead of concrete.

CHARLES A. ALLEN, City Engineer.

Wave Pressure on Exposed Structures.

PHILADELPHIA, Pa., Nov. 17, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In the communication from the Mechanical Engneer of the Lighthouse Board, published by you last week (Nov. 15), I beg to call attention to what seems to be an error in the calculation of the stability moment of the proposed Diamond Shoals lighthouse.

For this stability moment the writer takes the product of the number of tons in the structure, less its buoyancy, into the number of feet in the full half diameter of its base, which gives him $(14{,}708 \times 27)$ 397,124 ton-ft. Now, as building materials are crushable and the assumed supporting bed of sand not unyielding, it would hardly be good practice to rely upon these figures. A little consideration shows that under the assumed conditions, if the supporting bed of sand was capable of resisting a pressure of 6.4 tons per sq. ft. and no more, the structure with wind and waves quiet would be in unstable equilibrium, ready to topple over upon the application of the least force; also that if the sand's resistance was 20 tons per sq. ft. the structure's moment of stability would only be about $(12\frac{1}{6} \times 14{,}708)$, 183,850 ton-ft. E.

[The actual pressure was taken at 6.4 tons, and the safe load at only 9 tons. The point made by our correspondent seems a sound one in its substance. In a circular lighthouse especially it leads to serious over-estimate of stability to take moments about the very edge of the structure, without also assuming a large factor of safety, because the structure cannot possibly revolve about that edge in overturning. Long before there was an adequate overturning moment to make it do so, there would be a unit pressure on the leeward edge which would crush it or displace the sand beneath it so that the apparent factor of safety of $2\frac{1}{4}$ is really much too high on this account alone. If the true lever arm for this purpose be taken as $0.46\,R$ instead of R, as our correspondent computes it with apparent substantial correctness, the factor of safety falls from 2.5 to only 1.16. To determine the true lever arm a maximum pressure per sq. ft. which can be placed upon the sand

without displacing it or crushing the foundation must be assumed, and this being fixed and decreasing uniformly inwardly, and the total reaction of foundation being known (14,708 tons), we have the elements for determining the reaction at any point. If these reactions be represented by negative ordinates we shall obtain a cylindric ungula whose total volume will equal the total reaction of the foundation, and the position of its center of gravity will indicate the true lever arm. RANKINE (App. Mech., p. 242), says that this must not exceed $\frac{1}{4}$ R in circular chimneys.—ED. ENG. NEWS].

Hudson River and St. Clair Tunnels.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of Nov. 8 it is stated that the hydraulic shield which has been used with such success in driving the St. Clair tunnel resembles the Beach shield more than any other. In the *Scientific American* of Nov. 1 it is stated that the Beach shield was introduced in the Thames River and London Electric Underground, and St. Clair tunnel and the Hudson River tunnel.

It is but just to the inventor, Mr. GREATHEAD, to say that he was the inventor and chief engineer of the Thames and London system of shield and tunneling, and was also consulted by Sir HENRY TYLER in reference to the St. Clair tunnel, made the drawings for the shields, etc., and adaptations were made from the same for the work; also that he was associated with Sir JOHN FOWLER and Sir BENJAMIN BAKER in the reviving of the Hudson River project, and work is being conducted according to drawings and designs made by him, evidence of the same being in the hands of Mr. SIMON STERNE.

Yours very truly, CONSTABLE BROS.

[Our correspondent's view of this matter conforms with our own. The shield system of tunneling was introduced in the first Thames tunnel by Sir MARK ISAMBARD BRUNEL as long ago as 1825. The tunneling system invented by Mr. A. E. BEACH, and practically used in the construction of a short piece of tunnel in New York some twenty years ago, embodied some of the main features of the BRUNEL and GREATHEAD shields, in the short tube advanced by hydraulic jacks, the thin hood covering the building of the advance ring of brickwork, and in its horizontal cutting edges. Mr. GREATHEAD'S system includes all of these, and the radical departure of making the shell of the tunnel a continuous series of cast-iron rings, with provisions for grouting outside, air-lock for wet ground, etc. Practically, these tunneling systems all differ sufficiently to allow ample credit to each engineer for original design. The real credit belongs to BRUNEL, if to any one man.—ED. ENG NEWS.]

"142,857."

WILLET'S POINT, N. Y. H., Nov. 10, 1890

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Two weeks ago a note appeared in the NEWS respecting certain curious properties possessed by the number 142,857, and an explanation was desired. The properties mentioned are not peculiar to this number, but belong to all complete repetends—that is, those repetends which contain a number of digits, one less than the denominator of the generating fraction.

The number 142,857 is the circulating decimal 1-7, and, being complete, may be generated with digits in the same order from any point taking for the generating fraction the number of sevenths remaining at that point; thus 1-7, 3-7, 2-7, 6-7, 4-7, 5-7, are the remainders at the different digits, and any one of the fractions will produce the same succession of digits beginning at its own. An inspection will easily show why multiplication except by 7 or its multiples does not produce any change of digits. Other numbers possessing the same properties are:

0588235294117647=1-17.
0526315789473684211=1-19.
0434782608695652173913=1-23.

Yours respectfully, A. M. D'ARMIT,
Second-Lieutenant of Engineers, U. S. A.

The Skew Portal Problem.

NEW YORK, Nov. 4, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In regard to the skew portal problem I would suggest that the best way to treat it generally is as a problem in spherical trigonometry, which it really is. The same may be said of a great many other problems in connection with bridges, roofs and other iron and wood work. The application of spherical trigonometry to these problems is very simple and perfectly accurate, and the number of labor-saving formulas given in the best treatises on the subject is remarkable. A spherical triangle consists essentially of three intersecting planes which have only one point in common; the sphere is merely an auxiliary construction introduced for the purpose of aiding in the study of the subject. WILLIS WHITED.

[Our correspondent also sends us an explanation of the properties of the number 142,857, which appears to have been sufficiently explained.—ED. ENG. NEWS.]

Curving Rails for Curves.

CHARLESTON, S. C., Nov. 10, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Permit me to ask, through your columns, what the concensus of competent opinion is regarding the laying of rails upon curves. Should they or should they not be curved before laying? If yes, what is the maximum curve upon which a 70-lb. rail of ordinary pattern can be properly laid without curving? If no, is it possible to obtain and preserve a true bearing of the rail upon the tie on curves varying from 5° to 30° when laid with a 70-lb. rail? Finally, what is the verdict of experience as evidenced by the most advanced practice in the matter of laying rails upon curves with or without curving? W.

[The best present practice, and the all but universal practice on carefully managed roads, is to curve all rails for curves sharper than 3°, and usually for 3° also. They are often curved in place, however. We regard it as indispensable for the maintenance of good alignment that this practice should be followed; besides which, it costs little, and saves much more than its cost in trackwork.—ED. ENG. NEWS.]

Cement Testing Query.

DULUTH, Minn., Nov. 12, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In a paper on "Portland Cement Testing," read before the American Society of Civil Engineers, Dec. 1, 1886, by HENRY FAIJA, M. Inst. C. E., he describes a "steamer" for use in testing cements for soundness. Is there any reason why the same test should not apply to natural cements? My experience has been that they will not set hard, either in the vapor or in the water.

In the same paper he describes a patented mechanical stirrer for use in gauging cement for briquettes. Can you tell where it can be obtained? Yours, etc.,

C. E. LOCKE.

[Can any of our readers answer the query of our correspondent? Personally, we have no experience with the use of the "steamer" and do not know where the mechanical "stirrer" can be obtained. ED. ENG. NEWS.]

An Instructive Proof of the Need for Freight Train Brakes.

ROCHESTER, N. Y., Nov. 15, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: On Nov. 11, there was an accident at a trestle on the Buffalo, Rochester & Pittsburg R. R. near West Seneca. Workmen were engaged in repairing the trestle, and had taken out all the stringers on one side for a distance of 90 ft. The deck was "jacked up" on that side, and new stringers had been laid on the outer ends of the caps, ready to be put in place. Twenty-five minutes before removing the stringers the foreman had sent out red flags in both directions to hold trains until the work should be completed. Just as the carpenters were beginning to slide the new stringers in under the ties, a freight train came up, and as the engine ran on the trestle, it tipped over on one side, and plunged into the creek below, a distance of 10 ft. Eight cars followed the engine, and piling up behind it, and on each side, caused the entire trestle to collapse. The engineman went down with his engine, but succeeded in clearing himself from the wreck, and coming up from under the water was dragged ashore, and found to be but little injured. All the other trainmen jumped and escaped without a scratch.

Upon investigation it was found that the bridge flagmen had each gone out over a mile north and south from the trestle. The one to the south was seen by the engineman of the wrecked train over 6,000 ft. from the place of the accident, and it was there that brakes were called for and the engine was almost immediately reversed. At this point the grade descended toward the bridge at the rate of 62 ft. to the mile for a distance of just 2,000 ft., then for 1,500 ft. there was a down grade of 21 ft. per mile, and for the remaining half mile up to the trestle, the grade was level. The freight train was made up of 40 heavily loaded cars, drawn by a consolidated locomotive weighing 42 tons. There were 3 brakemen on the train, but the locomotive had no brake. The train crew claim that they did everything possible to stop the train, but that they were unable to hold it. A few brakes were found defective on the cars, but nearly all of them were probably in good condition. W. E. H.

[This accident is one of the most instructive examples of the need for freight train brakes, and for engine brakes at least, which has come to our knowledge. The flags were out nearly 1¼ miles, and yet a train of 40 cars could not be controlled in that distance because of the moderate but decided down grade.—ED. ENG. NEWS.]

Bridge Guard Rails.

MISANTLA, V. C., Mexico, Oct. 18, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: From a careful study of your article on "Guard Rails for Bridges" in connection with the communication of Mr. MCNICOL on the same subject (ENGINEERING NEWS, Oct. 4), one is led to the conclusion that the type of guard suggested by Mr. MCNICOL, viz.: two guard rails flaring inwardly to the center of the track, is a doubtful improvement over the old form. The following reasons for the conclusion are suggested:

The roadbed at nearly all bridge approaches is in embankment; and, if there is any place where the bank is likely to be a little slack or narrow, it is just at the junction with the bridge. Now, as you say, in all derailments the tendency is for the derailed wheels to drag along for a considerable distance within 6 to 18 ins. of the rails, until the erratic tendency becomes so strong as to compel the derailed wheels to assume a new or second position, or until a disturbed center of gravity makes the tendency to topple over outweigh the forward motion. This change probably occurs in a majority of derailments on a narrow bank at the approach of a bridge. There is then no second bearing place for the derailed wheels against the outer rail; but all, including the bridge, are brought to rest in the bottom of the gorge or channel. It is for such derailments as this (and I believe them to be the majority) that the Latimer guard is intended to be security. It catches the derailed wheels as they are about to slide to the second position and slews them back against the rails, where there should be rerailing blocks.

Mr. MCNICOL illustrates and describes a case wherein the Latimer guard is a detriment; but what of his own device? It carries the derailed wheels in safety over the bridge, where it seems most likely they will very soon after find the outer rail and wreck. It seems as if the merit of the device consists in saving the bridge and securing a better location for a wreck; appreciable merits; but why not take the Latimer guard as it is, and put Mr. MCNICOL'S flaring rails on the outside, beginning about one gauge out, and one rail length beyond the point of the diamond? Any derailed wheels that are not entirely beyond the rails may be brought back far enough in one rail length to catch on the Latimer guard and be rerailed at the bridge. F. MEREDITH JONES.

English and American Boiler Practice.

SYDNEY, New South Wales, Australia, Sept. 30, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Like Professor THURSTON, "I always read your journal with unalloyed pleasure, for I think it one of the best periodicals of its class in existence." Your article under this heading in your issue of August 2, was exceedingly satisfactory to me, as well as to many others, I dare say. The *Engineer* says the American locomotive boiler is "deplorably bad." What would it say to the following bit of *evidence* concerning 396 English locomotives—out of a total of 439—designed and built by the best firms in that country, for use here on these lines? An engineer from a neighboring Colony—an Englishman, who thoroughly believes in English goods only—was recently hired by a new General Manager—another Englishman—to examine and report upon the state of the rolling stock in New South Wales, and he wrote as follows: "I beg to mention that in *almost all your engines* there is, in my opinion, a serious deficiency of heating surface, with which to work economically, in the matter of fuel consumption." A little further down, on the same page of the same report, he shows his inconsistency by writing thus: "The alterations which I recommend for the suburban tank engines (referring to 18 new ones lately imported) is, to remove their existing cylinders, which are 15 ins. diameter and substitute for them, cylinders of 16 ins. diameter. The *existing heating surface, although small, will sustain this alteration.* These engines are not well proportioned, but the change proposed will make them much more suitable for their work than they are at present." A few lines below this he writes: "With regard to the (12 new) [engines, 373 class, known as the 'Vulcan,' (a type which has been more or less criticised in the *Engineer* and *Engineering*), I recommend that their cylinders, which are 19 ins. diameter, be removed and cylinders 18 ins. diameter substituted. An anxiety to provide sufficient power (to eclipse the American locomotives on these lines) for your growing traffic has over-cylindered these engines. The heating surface of the boilers, and the weight available for adhesion are nearly correct for cylinders 18 ins. diameter and 26 ins. stroke."

Fifteen months later this same person wrote: "Many of the locomotives, especially those running the Melbourne express trains, have executed *exceptional* mileage, far beyond their economic duty." This is said simply because 4 or 5 engines with 6-ft. wheels, running over level straight roads with a light train, did 45,592, 48,414 and 42,102 miles per annum respectively. He adds: "The consumption of fuel, 62.16 lbs. per *train mile*, or 45.72 lbs. per engine mile,

after allowing for our heavy grades, is too heavy. It is chiefly caused by the inadequate heating surface *in most* of the boilers, necessitating small blast orifices and quick draught in order to generate steam for the cylinders." A few months after the foregoing report was made an English engineer happened to be traveling in these colonies. He was asked by the same person to report, and, after "devoting seven weeks to a careful examination of our rolling stock," he wrote thus: "Adopting the mileage run by each engine *as the test of the present condition* of the locomotive stock, it is evident that before the stock can be put into anything approaching a proper condition for working the traffic at least 116 new engines of *the standard* types must be added to the present stock." "The number of new locomotives added to the stock during the past ten years has been 272, which gives 0.20 engines per mile of road." This same engineer said in May, 1887, that he had recently visited New Zealand, New South Wales and Victoria,* and had special opportunities of judging of performances of English and American engines in connection with *the question of cost;* he was able to say that, in regard to *economical results*, the rougher type of engine had a great advantage over the more highly finished engines, which were suited for the beautiful lines in England. In New South Wales he had seen some splendid specimens of English engines. We have 43 American locomotives on these lines, which do the heaviest and best work, 33 built in America and 10 in Scotland. There are 88 American-built 4-driver locomotives in use on the Sydney tramways, also doing excellent work since 1879. It is now freely admitted here that the American type of engine suits us best, especially the "mogul" class, with 18 × 26 cylinders and 79,000 lbs. on drivers. Ten more of this same class were recently imported from Scotland, and I have heard that 10 more were cabled for just a few days ago.

THOS. MIDELTON,
Late Locomotive Superintendent
N. S. W. Railways and Tramways.

Notes and Queries.

S. P.—The *argument* of a table is properly the columns at the side or across the top or bottom, or both, which serve to indicate what the table contains, and by which it is entered. The term *boxing* of a table is also used in the same sense, and we believe is the printer's term. It is a better and simpler term than "argument," which is not generally understood. It is obvious, however, that every table consists of two parts, the table proper, and the *argument* or *boxing* showing what the table is about, and what each line or column means. To designate what every number in a table is, there must obviously be an *argument* on at least two sides of the table.

R. R. S. asks: In your issue of March 15, 1890, you have an article about finding water by Mr. HEERDEGEN. Do you know anything further in regard to it?

[We know no more than we have told, and will not swear to all of that. Some people believe that Mr. HEERDEGEN has an electrical or magnetic instrument by which he can find flowing streams of water beneath the surface, and give their approximate direction, depth and volume. He has, to our knowledge, made some creditable tests, appearing to indicate the possession of such powers. We have no opinions to express, except that we look on all such claims with great skepticism, but that Mr. HEERDEGEN's manner is such as to inspire confidence in his personal integrity. He has come all the way from Russia to practice his art, and has an office in this city.]

The British and German Metallurgists' Excursion.

(*Concluded from page 425.*)

The excursion trains left Pocahontas, Va., at noon on Thursday, Oct. 23, and from that point the journey was continued with few stops to Washington. During Thursday night the trains lay at Roanoke, Va., in order that the travelers might ride by daylight through the beautiful Shenandoah Valley, where the forests were at the height of their autumnal glory. Friday afternoon the trains stopped for some hours at Luray, and the visitors were taken through the famous Luray cave.

At the present time the most active industry along the line of the Shenandoah Valley Ry. appears to be town-lot speculation. About every hamlet along the railway has suddenly determined to become great,—or at least as great as possible. In fact the excursionists visited no section of the South where land companies seemed as numerous as here. Just what should cause any remarkable growth of cities in this section it is a little difficult to see. There are deposits of brown iron ore along the valley of considerable richness, and every town which can raise the capital has aided its boom by building a furnace. But it will be a rather long haul to supply these furnaces with coke; the ore always requires washing; and it is a little difficult to see how any great amount of iron can be marketed from this section in competition with the product of furnaces in southwestern Virginia and in Alabama and Tennessee. It is of course true, however, that in the industries which build up towns and cities, the South, as a whole, has large opportunities; and a certain proportion of the ambitions cherished by some of these well advertised towns are likely to be realized.

* *Vide* Inst. of Mech. Engineers, Proceedings for May, 1887.

THE GUN SHOPS AT THE WASHINGTON NAVY YARD.

The excursion trains reached the Nation's capital in the small hours of Saturday morning, and during the day the train also arrived from the north which carried the party that went from Chicago to visit the mines of the north Michigan peninsula. No attempt was made to conduct the visitors about the city; but they were furnished with guidebooks and left to do their sightseeing where they pleased.

To an engineer, one of the most interesting things at Washington is the gun shop at the Navy Yard, which is equipped with modern machinery, and is managed, it may be pretty confidently asserted, with a view to turning out first-class work, and without regard for the interests of any political party. A novelty in these shops, which may sometime be less of a novelty, is the use of manila ropes for transmitting power from the main shafts to the countershafts, from which the lathes are driven.

The distance of transmission is short, not above 20 ft., and the ropes are run very slack. This is a necessary precaution, for most of the slack is taken up in damp weather, and a rope which is only moderately loose in dry weather may shorten so much on a damp day as to break the shaft. The pulley face has a half dozen grooves, which narrow toward the bottom, and the rope rides on the side of the grooves. The rope turns as it runs so that it wears equally on all sides. It requires no dressing or attention, and does not slip. This rope transmission has been used about a year, and has given excellent satisfaction.

There are two traveling cranes in the shop, one of which, recently erected, is of 110 tons capacity with a clear headway beneath of about 40 ft. It now serves only the shrinking pit and about 150 ft. of the north end of the shop; but eventually the girders and columns on which it travels are to be extended the whole length of the shop. The crane is driven by a square shaft, as is the smaller one of 15 tons capacity.

The tubes and hoops from which the guns are built up are furnished in the rough by the Bethlehem and Midvale works at the very pretty price of 38 cts. per lb. The turning and boring of these is the principal work in making the gun. The finishing must be done with a maximum error of $\frac{1}{1000}$ of an inch. This is not especially close working on articles of moderate size; but to attain such accuracy in turning and boring a gun tube, weighing perhaps 10 tons, the lathes must be able to carry the heavy load without straining, and must combine massive structure with accurate finish.

There are few if any shops in the country where harder service is demanded of lathes and turning tools than here. On the first turning of some of the rough forgings the tool is set to cut $\frac{5}{8}$ in. deep with $\frac{1}{16}$-in. feed. Indeed, cuts have been taken $\frac{1}{2}$-in. deep with $\frac{1}{4}$-in. feed. Allusion has been made to the high price of the gun steel; but the government is getting a return for its money, for the steel is of remarkably fine quality. The chips taken by the lathe tools show great elasticity and tenacity and twist away from the lathe tools like coil springs.

Cutting this steel is, of course, far more severe for both lathes and tools than cutting ordinary metal, and the Carpenter Steel Co., of Reading, Pa., which furnishes all the tool steel for the shop, is to be congratulated on the excellent results which its metal has shown in daily work. Tools of this steel have cut a shaving $\frac{1}{20}$ in. × $\frac{5}{8}$ in. from tempered steel forgings for 8 to 16 hours without sharpening, advancing 15 ft. per minute, thus cutting 7,200 to 14,400 lineal ft. of shaving without losing the cutting edge. In a test made at Washington on a bar of this steel containing 1.25 % carbon, the tensile strength was 126,408 lbs., elastic limit 75,629 lbs., and elongation 4.10 %. This was without any treatment. A piece of the same bar was heated to a deep red and quenched in cold water, thus making a water annealing, and when tested it showed a tensile strength of 115,609 lbs., an elastic limit of 66,972 lbs., an elongation of 13.8 %, and a reduction of area of 19.72 %. Another piece of the same bar was tempered in water at a bright red, and showed a tensile strength of 161,599 lbs., an elastic limit of 105,168 lbs., an elongation of 3.45 %, and a reduction of area of 4.74 %.

The greatest novelty in the whole shop to most engineers is the plant for shrinking the hoops upon the tubes of the gun. The accuracy with which the parts are finished has already been alluded to, and it is to be remembered that this accuracy is attained by the lathe tools alone. The finishing cut is taken by a tool with 1⅝ ins. face, which takes a shaving as thin as paper from the metal, and can finish to within less than $\frac{1}{1000}$ in. Of course much greater accuracy is attained in small work by the use of emery wheels; but here the lathe tools work with sufficient accuracy.

The shrinkage pit is deep enough to take the longest gun made at the shops. The tube is set on end in the pit and a stream of water is started running through its interior. The jacket is lowered into an oven on the opposite side of the pit, in the base of which is a soft coal fire. The coal is burned with a scant air supply to make a deoxidizing atmosphere in the oven. A shoe on the lower end of the jacket protects it from direct contact with the fire. The heating is done slowly and the final temperature aimed at is about 550°.

When the jacket is at the proper heat the top of the oven is taken off and the crane lifts the jacket from the oven. It is touched with a stick of alloy made of two parts tin to one part lead, to see that it has not been overheated, and a star gauge is thrust in to verify its internal diameter. The interior is then carefully swabbed out, and it is lowered onto a testing mandrel of wood lined with brass, of the same diameter as the exterior of the gun tube. This is the final test of the jacket's diameter; and if it does not stick here, it is raised and lowered at once on the tube.

On a 6-in. gun the interior diameter of the jacket is from 12 to 15 ten thousandths of an inch less than the exterior diameter of the tube. When the jacket is heated its diameter is about $\frac{1}{100}$ in. greater than the tube diameter, and it is perhaps ⅜ in. longer than when it is cold. If it were cooled equally along its whole length, it would shrink away from the collar on the tube against which it rests, and heavy internal longitudinal strains would be set up. For this reason the jacket is cooled at the butt end by streams of water from a perforated pipe ring, and the cooling, which takes about two hours, proceeds gradually along the jacket. The ring of metal at the butt which is first cooled contracts and takes firm hold of the metal of the gun tube, and shrinkage is almost wholly from the other end. When the jacket is cool the space between the butt of the jacket and the ring on the tube against which it rests when first put on is hardly the thickness of a sheet of paper.

The gun shop, however, was of little interest to most of the visitors compared with the Capitol, the Smithsonian Institute, the Government offices, and the various other objects of interest to sightseers for which Washington is noted. Among the latter is to be enumerated the President of the United States, who, with several members of his cabinet, gave an informal reception to the visitors in the afternoon. In the evening a promenade concert by the Marine band at the Arlington Hotel entertained the visitors.

THE PENNSYLVANIA STEEL CO.'S WORKS AT SPARROW'S POINT.

On Monday morning, Oct. 27, after a much appreciated Sabbath day's rest in the comfortable hotels of Washington, the trains were again taken, and a run of an hour and a half brought the party to Sparrow's Point, 9 miles from Baltimore, where the Pennsylvania Steel Co. is erecting a steel plant which, when completed, will be classed among the most important in the country.

There is a blast furnace plant of four stacks, each 25 × 82 ft., with a Bessemer steel plant of four 18-ton converters, equipped either to work the metal direct from the furnace, or the remelted metal from cupolas. The ingots from the Bessemer will be

rolled into blooms in a two-high reversing mill, driven by a pair of 42×60 reversing engines. A hydraulic shear at the end of the blooming train will cut off the ends of the blooms, and they will pass direct to the rail train where they will be rolled into rails without reheating. The rail train will be three-high with rolls 26 ins. in diameter, driven by two 48×66 in. Porter-Allen engines. Each ingot will make a single bloom, and this after passing through the rail train will be 6 rails (180 ft.) in length.

Of the above plant two of the blast furnaces only are now in operation. The other two furnaces are nearly ready to be blown in. The frame of the buildings for the steel department and rolling mills is up, and much of the heavy machinery has been placed.

The marine department of the works is to comprise an extensive plant for the building of steel ships. The buildings are now completed, awaiting the machinery which will prepare the material for the hulls of the vessels. A machine shop is still to be erected, and hoisting shears of 100 tons capacity.

On another part of the company's property a machine shop, foundry, and pattern shop have been put in operation, and are now engaged on the machinery needed in the construction and extension of the works. When the marine department is in operation, these shops will make the engines and other machinery needed for the equipment of the vessels. The foundry is especially well supplied with cranes for handling heavy works. Four hydraulic jib cranes are now in place, and a 50-ton electric traveling crane is to be added.

The system of charging adopted at one of the blast furnaces not yet in operation is such an innovation that its working will be watched with much interest. The charging cars are 4-wheeled with drop bottoms, and each holds about one ton of ore. Narrow gauge tracks run into the stock house and terminate at a pit, along which runs a very small electric transfer table. The cars, when filled, are pushed by hand upon the transfer table, which moves them out to the tracks which run onto the scales and onto the hoisting cage. After weighing, the cars are run upon the lifting platforms and hoisted to the top. They then roll by gravity over the mouth of the furnace and are automatically dumped at the center. The bell at the furnace mouth is lifted by a hydraulic cylinder.

A novelty in the design of the buildings throughout the whole plant is the use of columns made of railway rails. They are used not only for posts, but for compression members in all parts of the framing. Of course, the column contains a great deal more material than an ordinary rolled column of the same length; but on the other hand, the steel rails are rolled in the company's own mills, and cost probably not more than $25 per ton. Rolled channels, on the other hand, sell for about $60 per ton. It appears from this that there is room for a very large saving by the use of the rail column; and that engineers would do well to pay more attention to its use. For short columns and for places where much corrosion is to be expected, the rail is especially adapted. The heavy columns are made with four rails, having their bases outward, their ends resting in sockets in a cast iron base plate. At frequent intervals filling blocks are bolted between the rails.

The ore used by the furnaces is brought principally from the extensive Juragua Mines of the company in Cuba. This ore is among the very richest Bessemer ores now worked, containing about 65% of metallic iron. It is thus enabled to stand a length of transportation which would destroy the economic value of a lean ore.

Besides the plant above described, an extensive plant of open-hearth furnaces, with blooming mills, plate mills and structural mills, is projected to be erected at an early date. The completion of the whole enterprise as planned by the managers of the company will be a work of some years. The works of the company at Steelton, Pa., employ about 3,700 men and turn out about 1,200 tons of steel per day. When the two plants are in full operation the company will rank with the Illinois Steel Co. and the Carngie works in the magnitude of its operations.

To the courtesy of the company the excursionists were indebted for the last, and one of the very best, of the many elaborate lunches provided for their refreshment in their tour in the United States. Thorough justice was done to the delicacies provided, and then the party separated. Those intending to join the excursion to the Thomson-Houston electrical works at Lynn, with those who intended sailing immediately for home, came on to New York by a special train. The remainder of the party, numbering about 250, were treated to a steamer ride on Chesapeake Bay in the afternoon, and in the evening took special Pullman trains for Niagara Falls. From that place on the following day they started on the tour tendered by the Canadian government, to visit the principal cities of Ontario and Quebec, whither this chronicle will not attempt to follow them.

The Massachusetts Railroad Commissioners' Report on the Quincy Disaster.

In our issues of Aug. 23 and 30 a full account was given of the accident on the Old Colony R. R., Aug. 19, by which 23 persons were killed and 30 wounded. Advance sheets have just been received of the report on the disaster made by the Massachusetts Railroad Commission. It will be remembered that the accident was a derailment, caused by a track jack left in place beneath the rail by a section gang, who did not see the approaching train in time to remove the jack. In the investigation pursued, the Commission secured information from all the railways in Massachusetts and from eleven of the largest companies of the Middle and Western States. They find that no derailment was ever before caused by a jack or a track lever in Massachusetts. Of four cases reported on the other roads, in which jacks have been struck by trains, only one resulted in a derailment, from which, however, no serious injury resulted. In this and one other case the jack was between the rails, in two other cases it was outside the rail. With regard to rules regarding the use of jacks, no companies report any printed rules, but on two roads in Massachusetts and three of the other roads sending replies, verbal instructions have been given to use the jack on the outside of the rail.

The Commission reviews the various precautions which have been suggested regarding the use of jacks and recommends the following rules:

1. A track-jack should not be used either on the inside or the outside of the rail, nor should a lever bar or other similarly cumbrous instrument be used between the rails, unless such jack, bar or instrument is protected as required when the track is obstructed.

2. When repairs are being made which do not interfere with the safe passage of trains, the track should be clear of men and tools before an approaching train gets within a quarter of a mile of the point where the work is being done. On the approach of a train the section master should not only cause his men to leave the track as above, but, before he leaves the track himself, he should be satisfied that the track is free from tools, and otherwise safe. If for any cause the view is permanently or occasionally obstructed, the section master should take extra precautions to enable him to comply with the foregoing requirements; and, if the situation is such that he cannot or may not be able to ensure such compliance, then cautionary signals should be plainly exhibited on the track at such distance, not less than a quarter of a mile, as to give timely warning to approaching trains—in both directions if on single track—and should be kept there until recalled by order of the section master. In getting off the tracks, section men should, so far as possible, avoid crossing or standing on other tracks.

3. Tools, pieces of iron, of wood, or of other material used for track, signal, interlocking, bridge, carpenter or other work, should not be brought on the track or allowed to remain there except when needed for immediate use. Tools should not be dropped or laid between the rails.

The second rule in the above is the one which strikes at the root of the evil. Do not let the workmen wait until the engine is just upon them before getting off the track with their tools, thereby risking the lives of passengers and trainmen as well as their own. Such a rule can be enforced, for engine drivers always want a clear view of the track ahead, and if they are given a right to it they will report disobedience of the rule. Enforce this order—a clear track for the train when it is a quarter of a mile away—and special rules as to the use of jacks or other tools on the track will be little needed.

But an even more important lesson is drawn by the Commission from the accident concerning the use of brakes. The train was running at only 25 miles per hour, and yet it seems to have run 640 ft. after the brakes were applied, a large part of that distance over the ties, to say nothing of the work done in breaking engine and cars. It is an impressive consideration, that, had the cars been stopped 45 ft. back of their final position, no deaths or serious injury would have resulted from the accident. The ill-fated train was deficient in braking power in these respects: the engine was equipped with driver brakes, but they were operated by an independent handle and the engineer forgot to apply them. Had the driver brakes been used, the braking power would have been increased 8%. The Pullman car had no brake shoes on the center wheel of the six-wheeled trucks, thus causing a loss of braking power of between 3% and 4% of the total used on the train. Finally only 3 cars out of the 10 in the train had the latest form of quick-acting brake. Had these three deficiencies in the braking apparatus not existed, the Commission considers it possible, if not probable, that all loss of life would have been avoided.

Prompted by this accident the Commission made an investigation of the condition of brake equipment on Massachusetts railroads and found that the wrecked train was better equipped, as concerns braking power, than most Old Colony trains, also that the Old Colony road has better brake equipment than the average road in Massachusetts. The following table exhibits what must be characterized as a state of affairs thoroughly disgraceful to the managers of New England railways. It is the more so as every one of the eleven roads reporting is earning large dividends, with the sole exception of the New York & New England, which, be it noted, is so far ahead of its rich but penurious neighbors in this vital matter that every one of its passenger engines and all but four of its freight engines are equipped with driver brakes.

BRAKE EQUIPMENT OF MASSACHUSETTS RAILWAYS.

	No.	Per cent.
Number of passenger engines	806	
with driver brakes	225	28
with driver and train brakes operated by one handle	152	19
Number of freight engines	573	
with driver brakes	215	37½
with driver and train brakes operated by one handle	85	15
Number of passenger cars	3,030	
with train brake	3,030	100
with quick-acting brake	504	16
Number of freight cars	35,083	
with train brake	1,704	5
with quick-acting brake	1,069	3
Number of cars with six-wheeled trucks	106	
do with quick-acting brake	22	21
do with brakes on all wheels	6	5¼

The Commission well says, the condition of affairs shown by the table is not what it should be.

Accompanying the report is an excellent monograph on the subject of brakes by Prof. GEO. F. SWAIN. The author starts out with the statement that the brake is the most important safety appliance connected with railroads, and describing eleven of the worst accidents which have occurred on Massachusetts railways in the past 20 years, he shows how such great disasters as those at Revere and Wollaston would have been prevented, and many others would have been lessened in fatality if brakes of modern efficiency had been in use. The points on which especial stress is laid are the use of driver brakes operated by the same handle as the train brake on all locomotives, the application of brakes to every wheel of passenger cars, the adjustment of the leverage and the keeping in repair of the brakes to secure the maximum possible efficiency, and the use of the new quick acting brake in place of the old automatic as fast as it can reasonably be applied.

The Improvement of the James River at Richmond, Va.

At the recent meeting of the American Society of Mechanical Engineers at Richmond, Va., Mr. W. H. ADAMS, of New York, read a paper giving some description of the works which have been planned by Mr. C. P. E. BURGWYN, M. Am. Soc. C. E., Assistant Engineer in charge of the U. S. Government work on the James River Improvement, having for their object the development of the immense water power of the James River at and near Richmond and the improvement of the channel of the river from Richmond to the sea to enable ocean steamers to ascend the river to the Richmond wharves.

The drainage area of the James above Richmond is about 6,000 sq. miles. The measured discharge varies usually from 2,000 cu. ft. per second to 10,000 cu. ft. per second, and in freshets it is estimated that as much as 200,000 cu. ft. per second has been

discharged. In a distance of 13 miles above Richmond the river falls 115 ft. The total fall of the river from the gap in the Alleghenies where it takes its source, to tidewater is about 585 ft. By a system of storage reservoirs at convenient sites within 50 miles of Richmond, there could be guaranteed at least 4,000 cu. ft. per second at Richmond during the summer months, and it is calculated that from this 40,000 HP. could be developed. This compares with other noted water powers already developed as follows:

City.	Horse power.
James River at Richmond, Va., with reservoirs	40,000
James River at Richmond, Va., at present	25,000
Holyoke, Mass	12,260
Manchester, N. H.	12,000
Lowell, Mass	11,845
Lewiston, Me	11,000
Lawrence, Mass	10,902
Cohoes, N. Y	6,556

Richmond is located just at the junction of the highlands and the coast plain region of the South; so while on one side is this mammoth water power, on the other is a winding channel stretching for 127 miles through the lowland marshes to the sea. Of this distance 82% has now 22 ft. depth at mean low tide, and the improvement now in progress by the U. S. Government is intended to secure this depth over the shoals which form the remainder of the distance. The lower 98 miles is tide water, consisting of long, deep pools separated by mud shoals, which are now being dredged. When this depth is secured Richmond can compete with the Northern cities as a seaport, as she is 67 miles nearer the sea than Baltimore and only 17 miles farther than Philadelphia. The following data as to the depth of harbor entrances was given by Mr. ADAMS:

New York has now 21 to 25 ft. at low tide, with a mean rise of 4 ft. 3 in. = 29 ft. 3 ins. Philadelphia has on her bar 19 ft. at low tide, with a rise of 6 ft. = 25 ft. Norfolk has at her wharves about 25 ft. at low tide, with a rise of 3 ft. = 28 ft. Baltimore has 27 ft. at low tide, with a rise of 1½ ft. = 28½ ft. Richmond is promised 22 ft. at low tide, with a rise of 3½ ft. = 25½ ft.

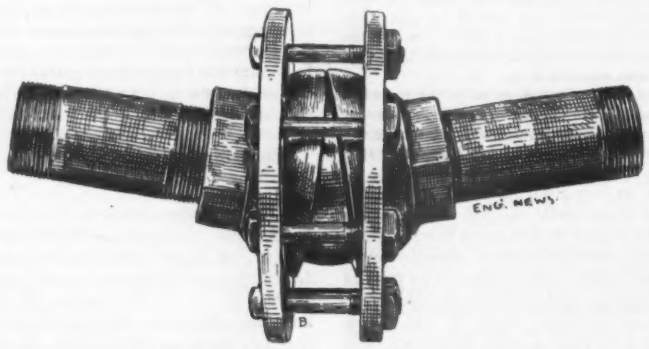
But in addition to this it is proposed by Mr. BURGWYN to continue the improvement until there shall be a channel 30 ft. deep at low water as far as Drewry's Bluff, 5 miles below Richmond, and it is stated that this can be done with the removal of only 29,000,000 cu. yds. of soft material, which it is believed can be done at a cost of $6,000,000. At Drewry's Bluff the project is to have lock gates, with basins and a canal fed by water from the James. Around these basins will be constructed dry docks, elevators, storehouses, etc. The total area of the three basins proposed is over 1,500 acres, and the total wharf frontage which would be furnished would be about 35 miles.

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF OCTOBER, 1890.
[Furnished to ENGINEERING NEWS by the Chief Signal Officer, U. S. A.]

STATION.	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maxim.	Direction at time of max. velocity.	Precipitation.—Rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.										
Northfield, Vt	44.0	74	21	53	12.3	36	N	3.49	1.04	15
Portland, Me	47.7	75	32	43	8.3	33	NE	6.82	2.32	14
New York City	56.0	74	38	36	10.6	44	NW	5.46	1.86	15
Pittsburg, Pa	54.2	78	35	43	5.4	25	W	5.66	1.91	20
Chicago, Ill	51.3	73	28	45	14.5	50	SW	4.20	1.16	15
Omaha, Neb	52.2	76	26	50	7.6	36	NW	1.09	0.31	9
St. Paul, Minn	46.4	71	22	49	6.6	29	SW	2.79	1.52	12
Duluth, Minn	45.0	66	24	42	6.6	25	NE	3.03	1.72	12
Bismarck, N. Dak	46.2	84	22	62	12.4	52	W	1.37	0.56	11
Average	49.2	74.6	27.6	47.0	9.4	36.7	.....	3.88	1.38	14
SOUTHERN CITIES.										
Washington City	56.0	77	30	47	7.0	30	NW	5.15	3.39	14
Louisville, Ky	57.9	85	35	50	6.3	37	W	3.69	.70	12
St. Louis, Mo	57.3	89	29	60	11.6	42	W	0.86	0.28	9
Savannah, Ga	67.0	89	41	48	6.3	30	NW	4.12	3.79	8
Leavenworth, Kan	55.8	79	29	50	4.9	24	S	3.86	2.50	8
Jacksonville, Fla	71.3	90	43	47	4.8	28	W	9.07	5.00	11
Chattanooga, Tenn	59.5	84	33	51	5.4	27	NW	4.13	1.76	12
New Orleans, La	69.0	87	49	38	8.0	36	W	5.24	2.63	7
Memphis, Tenn	61.8	86	34	52	6.3	30	W	2.75	1.66	10
Palestine, Tex	66.0	88	42	46	4.0	26	S	9.01	4.59	8
Average	62.2	85.4	36.5	48.9	6.5	31.0	.....	4.79	2 63	10
WESTERN CITIES.										
Helena, Mont	46.0	69	26	43	8.0	36	SW	.55	.25	7
Port Angeles, Wash	56.8	75	44	31	3.9	14	W	0	0	0
San Francisco, Cal	62.4	86	48	38	5.7	26	W	0	0	0
Salt Lake City, Utah	48.6	70	30	40	3.7	24	SE	1.44	.44	7
Denver, Col	49.5	75	25	50	6.3	30	NE	.64	.52	5
Yuma, Ariz	72.6	95	47	48	5.5	34	SW	1.79	1.70	2
Santa Fé, N. Mex	50.0	72	29	43	7.6	38	NW	.93	.73	4
Average	55.1	77.4	35.6	41.9	5.8	28.9	.....	0.75	0.52	4

Holmes Patent Flexible Pipe Joint.

The cut given illustrates a new flexible pipe joint patented by Mr. A. L. HOLMES, of Grand Rapids, Mich. The joint is adapted for use with water, gas, steam, compressed air, oil, etc., and the chief advantages claimed are that it will permit the passage of the fluid with the minimum friction, can be moved in any direction without leakage, and is readily attached and detached. It can be fitted to cast or wrought-iron pipes, and flanged or screw joints, and in sizes ranging from 2 to 36 ins. It has been tested up to 300 lbs. per sq. in.



HOLME'S FLEXIBLE PIPE JOINT.

The cut given shows the joint as applied to a threaded pipe. The outside of both ball and spigot ends are turned true and smooth, as are the inside of the detachable collars which hold the pipe ends together. The ball and socket joints are ground, and near the end of the ball is a copper gasket turned off $\frac{1}{32}$ in. flush, making a fit that is perfect and flexible. Long experience in pipe-laying under difficult circumstances, and a 5 years' trial of this especial joint proves that it is perfectly satisfactory in use. The cost is said to be as low as is consistent with good work and material.

THE NEW MUNICIPAL BUILDING COMMISSIONERS, Messrs. THEO. W. MYERS and F. T. FITZGERALD, have reported three sites for the proposed structure in this city. No. 1 comprises the block bounded by Broadway, Chambers, Church and Warren streets; building area, 51,600 sq. ft.; assessed value, $2,323,990; probable cost, taking assessed value as 60% of actual value, $3,873,316. Site No. 2, the ground east of the Emigrant Saving Bank, on Chambers St., and bounded by Chambers, Centre and Reade streets and the building named; building area, 48,.990 sq. ft.; assessed valuation, $1,232,000: probable cost, as above, $2,053,333. Site No. 3 is on the north side of Chambers St., between Centre St. and Park Row, extending north to a new Duane St. This would give a building site 223 ft., 111 ft., 344 ft. and 273 ft. on the sides, and the assessed valuation is only $587,000, leaving out a church valued at $162,-000. The estimated cost of this property is $1,331,-900. The commission recommends site No. 3 as being the cheapest in first cost and as permitting the erection of an imposing structure. It would also greatly enhance the taxable value of neighboring property, property which is now uninviting and neglected. In this increase in value the city would proportionally share.

A NEW CITY is to be started at the southern end of Lake Michigan by the great meat packing firms of Armour & Co., Swift & Co. and Morris & Co. This syndicate has bought 3,600 acres of land in Lake County and they will remove to this point their immense plants. The business of these three firms now amounts to $150,000,000 per annum, and it is expected that within the next five years they will concentrate on these lands a population of 150,000.

SLATE PRODUCTION IN THE UNITED STATES.—Census Bulletin, No. 8, is devoted to the report of Mr. WILLIAM C. DAY on the slate production in this country. For 1889, the total value of slate produced was $3,444,863, of which $2,775,271 was for 828,990 "squares" of roofing slate, and remainder slate devoted to other purposes. This is nearly twice the value and output of 1880. Pennsylvania has 104 out of a total 296 quarries, and Vermont comes next with 60 quarries and New York third with 16 quarries. In producing the amount of slate noted above, $2,823,668, out of the $3,444,863, is charged to the "total expense" of production, in wages and material.

The tools, live stock, machinery and supplies on hand, at the quarries in 1889, were figured at a value of $1,178,938; and the total capital employed was $10,042,293. The total number of persons employed in this industry was nearly 6,000. These quarrymen are largely Welsh or of Welsh descent. The average wages paid in Pennsylvania are: foreman, $2.25; quarrymen, $1.88; mechanics, $1.54; laborers, $1.40; boys, $0.73. The Vermont and New York rates are slightly higher.

THE NEW MASONIC TEMPLE FOR CHICAGO, of which the corner stone was laid last week, will be the tallest building in tall Chicago. The building will cost $2,000,000 and be 20 stories high. There will be 16 elevators with a capacity of 4,000 passengers daily for each one. The various stories are to be named after well known Chicago avenues. The first 17 stories will be rented for offices and the upper three floors used by the Masons. This building will be 275 ft. high to the peak of the roof.

AN ANTARCTIC EXPLORING EXPEDITION will start next year, under the auspices of the Australian government and Mr. DICKSON, the Swedish promoter of Polar enterprises. Prof. NORDENSKIOLD will either command or occupy a prominent position in the expedition. Dr. NAUREN will also start for the North Pole from Norway in February, in a ship of 170 tons especially built for his purposes, and so constructed that a "nip" in the ice will simply force his ship out of the water. He is provisioned for five years and 12 men only will accompany him. This expedition is promoted by King OSCAR and Mr. DICKSON.

THE UNIVERSITY OF NEW BRUNSWICK has introduced a course of engineering into its curriculum for the first time this year.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Baltimore & Ohio.—An endeavor is being made by the people along the route to secure the extension of a line from Lexington to Lynchburg, Va. It is stated that the company will take the matter into consideration and reach a decision at an early date.

Wilkesbarre & Western.—Construction is now in progress on the extension from Watsontown, Pa., to a connection with the Bloomsburg & Sullivan R. R., a distance of 32 miles. It is expected to have 10 miles of track laid by June 1, 1891.

Midland (Indiana).—At a meeting of the citizens of Brazil township, Indiana, recently held, it was decided to ask the County Commissioners for an election to vote on subsidizing the proposed extension of this road from Anderson to Brazil, Ind. The tax asked is $29,000.

Wheeling & Lake Erie.—Rails have been laid on the extension to Martin's Ferry O., from the Y., at Portland to a point some distance below that place and from Yorkville to Deep Run, O. The grading is all completed between Portland and Rainey's coal works. It is expected to have the line completed toMartin's Ferry this season.

New York, New Haven & Hartford.—The directors of this company are reported to be considering two plans for avoiding the grade crossing at Bridgeport, Conn. One is run on elevated tracks over the present line and to have an elevated depot, and the other is locate a new line crossing the north end of the city and to abandon the present depot. The first plan will involve an outlay of about $1,000,000 if carried out.

Lackawanna & Montrose.—Grading on the line from Montrose, Pa., to Alford Station, has been suspended for the winter. The bridge work will continue during the winter. About 60% of the roadbed is ready for the rails.

Rome, Watertown & Ogdensburg.—All of the right of way has been secured for the extension to Buffalo, N. Y.

Penobscot Shore Line.—The $25,000 subsidy asked of Rockland, Me., having been raised this company has decided to build the line from Rockland to Camden, Me., at once. The total cost will be about $250,000.

Lake Shore & Michigan Southern.—The Silver Creek & Dunkirk R. R. Co. has been chartered in New York in the interest of this company to build a railway from Silver Creek to Dunkirk, 8½ miles. The line is merely a "cut-off" to avoid heavy grades and will be completed at once.

Cleveland, Cincinnati, Chicago & St. Louis.—A line is projected to run from Greensburg, Ind., by way of Laurel, Liberty and Eaton to Dayton, O., from which point it will connect the Eastern division of this road.

Western New York & Pennsylvania.—Contractors are looking over the line preparatory to commencing work on the branch from Nunder to Swan's, Pa. It is expected that the line will be completed in two months.

Projects and Surveys.

Franklin & Kennebec.—Preparations are being made to begin work on this Maine railway from Farmington to Gardiner, Me., as soon as the charter is granted.

Bristol & Richmond.—Chartered in Vermont to build a railway from the Rutland R. R. to Richmond, Vt.

Lehigh & Pittsburg Construction Co.—Chartered in New Jersey for the purpose of building railways in the United States, Canada and Mexico. Among the incorporators are: John B. Bissell, of Elizabeth, and Frederick Knowland, of Plainfield, N. J.

Toronto, Hamilton & Buffalo.—Right of way is being procured, and it is expected that contracts for construction will be let soon. E. B. Wingate, Hamilton, Ont., Chief Engineer.

Canada.—A press dispatch says:

Mr. S. J. Ritchie, of Akron, O., representing the Standard Oil Co., which is operating in the Sudbury nickel region, has presented a petition to the Dominion Government asking for aid in building a railway from Coe Hill, Ont., to Sudbury, and for a 10 years' guarantee of $5,000,000 to enable him and his associates of the Canada Copper Co. to establish a plant for manufacturing nickel steel at Sudbury.

Plymouth & Middleboro.—The preliminary survey for the new line from Plymouth to Middleboro, Mass., 15.6 miles, has been completed. Location will begin at once.

SOUTHERN.—Existing Roads.

Bristol, Elizabethton & North Carolina.—At a recent meeting of the stockholders the following directors were elected: A. D. Reynolds, J. I. Cox, J. M. Barker, John C. Anderson, B. L. Dulaney, S. L. King, W. A. Spurger, M. B. Wood, and B. G. McDowell. The grading has been completed from Bristol to Elizabethton, Tenn., and track laying will begin soon.

Tennessee & Coosa Valley.—Allison, Shaffer & Co., have the contract for building the extension to Guntersville, Ala.

Macon & Atlantic.—The contractors, J. S. McTighe & Co., will let contracts for 180 miles of tracklaying and 40 miles of station work.

Asheville & Craggy Mt.—Work is in progress on the 4-mile railway to the top of Sunset Mt.

Roanoke & Southern.—At a meeting of the directors of this company and of the Virginia & North Carolina Construction Co., recently held, it was decided to build the line through Rocky Mount on condition that a subsidy of $25,000 be granted. It was also decided to award the contract for the section from Martinsville to Rocky Mount, Va., at an early date.

Norfolk & Western.—This company will make important additions to its terminal facilities and shops at Norfolk, Va.

Alabama Mineral.—Construction is now in progress on the new line from Boswell's Station to Talladega, Ala. The object of the new line is to do away with the heavy grades and curves on that portion of the old line.

West Virginia Central & Pittsburg.—Arrangements are being made to build the extension of this railway into the recently purchased coal lands of the company. These purchases have been made with the purpose in the early Spring to extend the road from Elkins to Peilippi, W. Va., thence along the valley of Tygart river to Grafton on the Baltimore & Ohio, thence to Fairmont, and thence to Fairchance, Penn., connecting with the Southwest Pennsylvania. Southeast from Elkins three engineer corps are now running lines through Webster, Pocahontas, Greenbrier and Monroe counties, and thence across the mountains to a connection with the Chesapeake & Ohio at Goshen, Va.

East Shore Terminal.—The Blackville, Alston & Newberry and the Barnwell railways have been purchased by the South Carolina Ry. Co., the East Shore Terminal Ry. Co. guaranteeing the bonds. The Barnwell R. R. runs from Blackville to Barnwell C. H., S. C., is 9 miles in length and is laid with steel rails. It was constructed and opened in 1882. The Blackville, Alston & Newberry R. R. is projected from Blackville to Columbia, S. C., 50 miles, and is completed from Blackville to Severn, 30 miles. The total cost of its construction and equipment was $275,026.

Escambia.—J. J. Sullivan, of Flomaton, Ala., writes as follows:

This road is being built in the interest of the Sullivan Lumber Co., and will penetrate the pine timber lands owned by the company. It will run from Sullivan, Ala., to Sullivan Mills, Steadham and Weatherford, Ala., with a branch from Wallace to Escambia Forks, a total distance of 60 miles. Twenty-seven miles are already completed and 3 miles of the extension are located. The work is light, with easy grades and curves. All work is being done by the company. It is intended to have a portion of the line opened for general traffic by Jan. 1. M. H. Sullivan is President and W. F. Lee is Chief Engineer, both of Pensacola, Fla.

Middle & East Tennessee.—The grading has been completed on the section from Gallatin to Hartsville, Tenn., and it is stated that work will begin on a further extension to Carthage, Tenn., soon. The rails are now on the route, and as soon as they arrive tracklaying will begin. J. C. Rodemer & Co., are the contractors.

Projects and Surveys.

Cincinnati, Georgia & Florida.—Surveys have been completed from Harrison, Ga., via Graysville, Ga., to the Chicamauga National Park, and thence west via Rock Springs to Kensington, Ga. F. A. Vaughan, of Graysville, Ga., is interested.

Birmingham, Jackson & Kansas City.—It is announced that the money has been secured to build this railway, and that construction will soon begin between Jackson and Florence, Tenn. Surveys are now in progress, and nearly all the right of way has been secured. J. J. Williams, of Jackson, Tenn., is Chief Engineer.

Branford & Dunnellon.—The preliminary survey for the line between Branford and Dunnellon, Fla., is in progress.

Thomasville & Southern.—This company has secured a charter for the portion of its line from Thomasville, Ga. south to the Florida State line.

Georgia.—Bills have been introduced into the Georgia State Legislature incorporating the Atlanta & Northwestern Ry. Co., the North Highland R. R. Co., the Vernon Park Ry. Co., and the Suburban & West End Ry. Co.

NORTHWEST.—Existing Roads.

Chicago & Northwestern.—The people along the route are again agitating the question of securing the early construction of the extension of the Moville branch of this road to Sioux City, Ia.

Duluth & Winnipeg.—The Secretary of the Interior has approved the location of this line through the Indian Reservations in Northern Minnesota, and has called a council of the Indians to decide upon the compensation for right of way.

Minneapolis, St. Paul & Sault Ste. Marie.—Work has been suspended on the extension from Boynton north on account of the cold weather. It is stated that this company will build extensions from Aberdeen to Bismark, N. Dak., and from Hankinson to Jamestown, N. Dak., and will complete the Boynton branch during the coming year.

Duluth, South Shore & Atlantic.—The surveys have been completed and right of way secured for an extension from Negaunee to Gladstone, Mich. The line is already completed from Negaunee to Palmer. The tracks of the Minneapolis, St. Paul & Sault Ste. Marie R. R. will be used to enter Gladstone. From Palmer to a junction with the latter line is a distance of about 40 miles.

Projects and Surveys.

Kankakee Valley & Belt.—This company has been chartered in Illinois with principal offices at Chicago. The road is to be constructed from a point near the mouth of the Kankakee River, up the valley of that river, through the cities of Wilmington and Custer in Will Co. and Saline and Limestone in Kankakee Co. to Memence, and thence to eastern boundary line of Illinois. The capital stock is $7,000,000. Incorporators and first board of directors: J. Pembroke Bishop, Hiram A. Harries, Walter Thomas Mills and Cornelius D. Pain, of Chicago; Camden Knight, of Custer Park, and John D. Smilley, of Custer, Ill.

Chicago, Paxton & Cayuga.—Chartered in Illinois to build a line of railway from Paxton, in Ford Co, southeast through Vermillion Co. to a junction with the Chicago & Eastern Illinois R. R., the Toledo, St. Louis & Kansas City R. R. and the Indiana Midland R. R. at the village of Cayuga, Ind. The principal office is to be at Chicago, and the capital stock is $2,000,000. The incorporators and first board of directors are George W. Cole, C. Porter Johnson, Richard A. Allen and H. Willett, of Chicago, and Stephen D. Clifton, of Danville.

Omaha & South Dakota.—An official is quoted as saying that work will be commenced on this line next season. The survey is complete from Forest City, S. Dak., via Mitchell and Ponca, to Omaha, Neb, and a small amount of grading has been done between Blunt and Forest City. W. W. Olney, of Blunt, S. Dak., is Chief Engineer.

SOUTHWEST.—Existing Roads.

New Orleans & Northwestern.—Construction has been discontinued on the extension from Rayville, La., north until next spring.

Fort Worth & Rio Grande.—It has been decided to build the extension to Llano, Tex., at once.

Chicago, St. Paul & Kansas City.—Two surveys have been made for the line from Savannah to Tarkio, Mo., and as soon as one is decided upon construction will commence. It is stated that construction will also begin soon on the line to Des Moines, Ia.

Corpus Christi & South American.—Griffin Bros., of Minneapolis, Minn., who have the contract for building this road, have already commenced work. The road is to run from Corpus Christi to Brownsville, Tex. It is stated that the bonds have been purchased by the Holland Trust Co., of New York City, and that the money necessary to build the road is all secured.

Projects and Surveys.

Hope & Lewisville.—Chartered in Arkansas to build a railway from New Lewisville to Hope, Ark., 25 miles. Among the corporators are: C. E. Bramble, W. R. Kilby and G. A. Roberts.

Monroe & Shelbyville.—A project is on foot to construct a railway from Shelbyville to Monroe, Ark.

Aransas Pass & Harbor Island.—This railway is now being located from Aransas Pass to the Government lighthouse on Harbor Island. This section of the road will consist almost entirely of trestlework across Aransas Bay.

St. Joseph & Kansas City.—A press dispatch says that a company will soon be formed to build a railway from St. Joseph to Kansas City, Mo. The object of the new company is to secure a shorter line between these two places. E. L. Martin and L. R. Moore, of Kansas City, are interested.

ROCKY MT. AND PACIFIC.—Existing Roads.

Canadian Pacific.—The Shuswap & Okanagon Ry. Co., has marketed £127,500 of first mortgage bonds, the proceeds to be used in the construction of its line. The road is to run from Sicumons, B. C., to Vernon and Lake

Okanagon, B. C., 51 miles. Construction in now in progress.

Jacksonville & Medford.—The grading is nearly completed and tracklaying will begin as soon as the material arrives. The line is from Jacksonville to Medford, Ore.

Burlington & Missouri River.—It is reported that with the proceeds of an issue of bonds soon to be made by this company, the Black Hills branch of this road, now being graded west of Newcastle, Wyo., will be extended to Helena, Mont., making a connection at Billings with the main line of the Northern Pacific, and thence along the Musselshell River through the Castle mining district. A Yellowstone Park branch is also among the probabilities. It is proposed to grade about 100 miles of road beyond Merino, Wyo., this year on the extensions from near Cheyenne to a point about 50 miles south of Buffalo, in the northwestern part of the State. The rails will probably reach Merino before the close of the year. On the extension of the Grand Island Wyoming Central through South Dakota, 44.5 miles of track have been laid since June between Edgemont and Custer, S. D. On the Grand Island and Northern Wyoming the track has reached a point 30 miles northwest from Newcastle.

Seattle, Lake Shore & Eastern.—Tracklaying has been completed to the Skagit, with the exception of a gap of 2 miles, and the rails to fill this gap are on the ground. The first train will run through to Sedro about Nov. 25, the construction of a bridge over the Nookachamps being a cause of some delay. Track is laid from Sedro to the Samish, 10 miles farther, where a bridge is being built. The grading is finished to the boundary, and only the tracklaying and bridge-building remains. The Canadian end of the road is well advanced, and connection at the boundary will be made by Jan. 1. As soon as track is completed to Sedro, trains will run through to Anacortes over the Seattle & Northern R. R.

Ellensburg & Northeastern.—The Ellensburg & Northeastern Construction Co., which proposes to build this railway from Ellensburg, Wash., into the Conconully mining district, has filed articles of incorporation. The incorporators are: J. D. Caughran, Isaac W. Anderson, and J. R. Patton. The capital stock of $100,000 is to be divided into 100 shares of $1,000 each.

Southern Pacific.—Construction is now in progress on the extension from Los Banos, Cal., to Armona Point, Cal., 68 miles. A greater part of the grading was completed some time ago and it is expected to have the line in operation soon.—Grading is in progress from Avon to Concord, Cal., on the San Ramon Branch. Fitzgerald Bros., of Oakland, Cal., are the contractors.

Utah.—A press dispatch in speaking of the projected railway construction in Utah Territory says:

There are now in process of construction or organization with every reasonable possibility of being carried successfully through, these lines: The Milford extension of the Union Pacific from Milford to Pioche, just over the Nevada line in Lincoln county, 145 miles—all graded; the Utah, Nevada & California road between Salt Lake and Los Angeles via Southern Nevada, 350 miles in Utah, rights of way secured and bonds now being floated; the Deep Creek road running from the coal beds 25 miles northeast of Evanston, Wyoming, through Salt Lake City west to Clifton mining district just over the Nevada line, 260 miles, graded in spots, 225 miles in Utah; extensions now being built on the Utah Central, 125 miles, nearly all graded; the Castle Valley road from Price station on the Rio Grande Western 40 miles into the Southern fields of iron, coal, asphaltum, mineral wax, etc.; the Utah and Idaho road, now organizing to run north and west from Skull Valley Station on the Deep Creek road, cutting the Central Pacific at Lucin station, 146 miles from Ogden and 126 from Salt Lake direct, crossing the Oregon Short Line near Shoshone station, and running via Hailey to the Salmon river in Idaho, 260 miles, of which only about 75 are in Utah. This makes a total of mileage projected in this territory of 960 miles.

Sumter Valley.—Work is progressing rapidly on the line from Sumter, Ore., to a connection with the Union Pacific Ry. at a point near its crossing of the Powder River.

Projects and Surveys.

Clear Lake and North Pacific.—This company will build a narrow-gauge railroad from Clear Lake to the Donahue R. R. Lake County will give a subsidy of $40,000 and right of way. The road will be completed by July 31, 1892. Surveys are now in progress.

Edmonds & Eastern.—This company is to be chartered in Oregon to build a railway from Edmonds, Ore., east.

FOREIGN.

Colombia.—The Government of the Department of Antioquia, Republic of Colombia, South America, is prepared to grant a concession for the construction, equipment, and maintenance of a railway from Puerto Berrio, upon the River Magdalena, to the City of Medellin, a distance of about 130 miles. There are already 30 miles of narrow-gauge railway (3 ft. 0 in.) constructed and in perfect working order, the contemplated line being an extension of the existing system. Proposals, stating the terms upon which this work would be undertaken, are invited by James H. Tozer & Son, Botolph House, Eastcheap, London, England.

Africa.—Work will be commenced at once on a railway from Bagamoyo to Darhes-Salaam. The contractors for the rails are Mannesman & Sons, of Berlin.

Brazil.—A press dispatch says:

Mr. James W. Wells, who for many years has been prominent in the Brazilian railroad surveys, has recently supplied some interesting facts with regard to the lines which Brazil is now extending many hundreds of miles into the hitherto almost inaccessible interior. He says the Mogyana railroad is to be the great central line of the country. It has now entered the State of Goyaz, has nearly reached the capital of that State, and will be rapidly extended to Cuyaba. This town, on the Paraguay, is 1,000 miles from Rio de Janeiro, and the trading caravans between the sea and Cuyaba have often been several months on the way. Another great system of lines, 1,600 miles in length, is building from Sao Paulo to Rio Grande de Sul, along the uplands back of the coast mountain ranges, an enterprise that will place Rio de Janeiro within easy reach of the southern part of the republic.

CITY TRANSIT.

Electric Railways.—New lines or extensions are proposed as follows: Albany, N. Y., by the Watervliet Turnpike & Railroad Co.; Portland, Ore., address the Pacific Cable Construction Co.; Chattanooga, Tenn., address the Chattanooga & Northside Ry.; Lexington, Ky., address the Belt Electric Line Co.; Ottawa, Can., address Ahern & Soper; Joplin, Mo., address the Joplin Electric Ry.

Danvers, Mass.—The Naumkeag Street Ry., using the trolley system, has been refused permission to operate lines by a vote of 384 to 121.

Lowell, Mass.—The Lowell and Dracut Street Rys. have received permission to use the single or double trolley or the storage battery system of propulsion.

Boston, Mass.—The last annual report of the directors of the West End Street Ry , states that the gross earnings for the past year were $5,780,083; the operating expenses, $4,234,041; net earnings, $1,546,042; the total cost of the road, equipment and real estate, has been $15,690,707. The company now operates 256.78 miles of track. The horse car mileage during the year was 14,353,617; that of the electric cars, 3,311,473. The report states that "wherever the electric lines have been installed, traffic has enormously increased."

Bridgeport, Conn.—The *Electrical World* states that the Bridgeport Horse Ry. will probably be operated by the Thomson-Houston system.

Brooklyn, N. Y.—The State Railroad Commission has approved the application of the Brooklyn City R. R. to change its motive power from horses and steam to the electric single trolley system.

Syracuse, N. Y.—The Genesee & Water St. Ry. will lay double tracks on its lines and introduce electricity.

Pittsburg, Pa.—It is reported that the Second Avenue Electric R. R. will be extended to Homestead, a bridge being built on the extension at Glenwood.

Manchester, Pa.—The Pittsburg, Allegheny & Manchester Traction Co.'s line will probably not be in operation by electricity before late next spring, according to the last reports.

Uniontown, Pa.—The A. C. Townsend Railroad Building Co., Pittsburg, is reported to have received a contract for the construction of 1¼ miles of electric railway in this city. The cost of the entire plant is estimated at $50.000.

Baltimore, Md.—The North Avenue Ry. has petitioned for the right to lay a double track electric railway through several streets, the lines to be operated in part as an elevated road.

Macon, Ga.—The Progressive Loan & Improvement Co. has bought the Macon Electric Ry. for $250,000.

Chattanooga, Tenn.—The North Chattanooga Street Car Co. is building a line, to be 5 miles long and operated by electricity. The road will run through the property of the Chattanooga Land, Coal, Iron & Ry. Co.

Venice, Ill.—Surveys are now being made for the East St. Louis, Brooklyn, Venice & Newport Electric Street Ry.

Racine, Wis.—The People's Street Car Co. has applied for a franchise to build an electric line. The company is reported to have a paid up capital of $150,000.

Los Angeles, Cal.—The Main Street Cable Ry. has applied for an amended franchise, granting the right to use electricity.

Vancouver, B. C.—The Edison General Electric Co. has closed a contract for a 15-mile electric railway between this city and Westminster.

Horse Railways.—*Asheville, N. C.*—The Asheville Loan, Construction & Improvement Co. has received a franchise to construct the railway mentioned in our issue of Nov. 1.

Memphis, Tenn.—The Union Railway Co. has received permission to build a street railway through a number of streets; work must begin by Feb. 6, 1891, and be finished by July 7, 1892.

Helena, Mont.—A petition for right of way for a street railway has been filed by P. Winnie and others, who propose to commence work within 60 days of the granting of the franchise.

Cable Railways.—*New York City.*—Work on the Third Ave. line will probably begin within a fortnight.

San Francisco, Cal.—The City Railroad Co., has applied for permission to extend its system.

Dummy Railways.—*Birmingham, Ala.*—Work on the Birmingham and Jones Valley R. R., has been begun between this city and Avondale.

Florence, Ala.—The dummy line is stated to have been bought by a syndicate which will put it in good running order.

Spokane Falls, Wash.—Riblet & Strack report the completion of the Arlington Heights Motor Ry., of which they were the engineers.

Elevated Railways.—*Montreal, P. Q.*—The Montreal Park & Island Co., is reported as ready to begin construction. It received its charter five years ago, and the company was organized three years later. The roads will be carried on a single line of posts in the center of the roadway and the present intention is to use electricity as a motive power.

Chicago, Ill.—The City Council, on Nov. 13, authorized the construction of the Lake Street elevated road by a vote of 47 to 11.

New Companies.—Central Street Electric Ry., Beaver Falls, Pa.; capital stock, $60,000; incorporators, J. C. Whitla, A. R. Leyda and others. Cumberland Gap, Tenn., Street Ry. Hagerstown, Md., Street Ry.; President, C. W. Sebold; Secretary, J. D. Main. Anacortes & Skagit Motor Ry., Anacortes, Wash.; capital stock, $200,000; Houston, Tex., Belt Ry.; capital stock, $300,000; T. P. Nichols, General Manager. Citizens' Ry., Co., Jamestown, N. Y.; capital stock $200,000: directors, P. C. Templeton, J. Cowles, J. B. Asher and others. Union Electric Ry., Saratoga, N. Y.; capital stock, $300,000; directors. L. H. Cramer, G. I. Humphrey, W. H. Bockes and others. Saratoga, N. Y., Rapid Transit R. R.; capital stock, $30,000; incorporators, G. W. Morton, G. I. Humphrey, L. H. Cramer and others.

HIGHWAYS.

Pennsylvania.—The Allegheny Council will purchase the Saw Mill Valley and New Brighton toll roads. The committee appointed by the road convention recently held at Pittsburg has made its report; it recommends the election of road supervisors, who should perform their work without salary, and that overseers should be engaged to supervise the work in person. Also that the system allowing farmers to work out their road taxes be abolished, and that every farmer be compelled to pay the tax in cash.

Canada.—In Ontario there is some agitation for better roads. The London (Ont.) *Free Press* makes the following remarks: "Every fall and spring, as the mud roads become almost impassable, there is a great outcry among the farmers and the traveling community about the state of the roads. The Farmers' Institutes meet and pass resolutions in favor of having better roads. Last winter and spring nearly all the Institutes in Ontario took the question of bad roads up, and something was going to be done. Papers published in the remoter districts took the matter up. Then the subject was referred to a special committee of the Ontario House. And this is generally the end of the whole thing. As soon as the spring rains are over and the ground becomes dry and settled all interest in the road ceases."

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Gardiner, Me.*—A bridge across the Kennebec River at this place is talked of. The structure would cost about $100,000.

Schaghticoke, N. Y.—The town board has authorized the supervisors to raise $11,000 for defraying the expenses in the construction of two iron bridges, one at Valley Falls and one at Johnsonville.

Talbot Co., Md.—A joint meeting of the county commissioners of Talbot and Caroline counties was held recently to locate a bridge across the Tuckahoe River, pursuant to an act of Assembly passed last winter. It was determined to build the bridge from a point about 100 yards south of Horsey's Landing on the Caroline side, straight across the river to William's Grove on the Talbot side. This bridge will shorten the driving distance between Easton and Denton about seven miles.

Duquesne, Pa.—The plans for the new wagon bridge at this place have been approved. The bridge will be 65 ft. high, and have two spans each 300 ft. long.

Chicago, Ill.—Official action to decide upon the width and other details of the viaduct to be constructed across Ogden ave., at Rockwell St. will probably be taken about Nov. 21.

WATER-WORKS.

NEW ENGLAND.

Conway, N. H.—The works have just been satisfactorily tested. F. A. Snow, Providence, R. I., was contractor.

Greenville, N. H.—A fire protection system has been completed.

South Wolfborough, N. H.—The Wolfborough works have been extended 2 miles to supply this place. Mr. Snow, as above (under Conway), was contractor.

Lowell, Mass.—The city engineer has published, under date of Aug. 23, a very complete plan showing the location of the filter gallery, conduit, pumping stations, reservoir, force and distributing mains, and profiles of this system of water-works. These plans, while of more local than general value, indicate a business-like method of conducting the affairs of the office, and they would serve as models for even more important cities.

Easthampton, Mass.—A move is on foot to increase the supply by drawing from additional springs or streams on or near Mt. Tom.

Merrimac, Mass.—Application, in the usual form, has been made to the Legislature by T. J. Little, H. O. Delano,

George Adams and others for the incorporation of the Merrimac Water Co.

MIDDLE.

Northville, N. Y.—The construction of the new works will be superintended by E. Brown Baker, City Engineer of Gloversville.

Round Lake, N. Y.—The Round Lake Association is building another reservoir.

Syracuse, N. Y.—Residents of Kirkpatrick St. have organized and incorporated the Kirkpatrick Well Association and elected George Starr, Donatus Smith and three others as trustees. A well will be dug for a general water supply.

Westchester, N. Y.—The New York & Westchester Water Co. has been incorporated by John F. Hume, Poughkeepsie, Joseph M. Low, of Kingston, and others, with a capital stock of $500,000.

Collingswood, N. J.—Works are projected by the Collingswood Water Co.

Hammonton, N. J.—Works are projected.

Chambersburg, Pa.—A. C. McGrath, superintendent, informs us that a new reservoir is about to be built and that the pumping station will be moved.

Lititz, Pa.—The Lititz Water Co., formerly supplying water for street sprinkling only, will increase its capital stock from $1,000 to $25,000 and extend its works.

Pittsburg, Pa.—The South View Water Co., recently chartered, proposes to supply the whole South Side with water taken from the Monongahela River above Beck's Run and filtered by the Pasteur-Semen system.

SOUTHERN.

Henderson, N. C.—It is reported that Woltman, Keith & Co., 11 Wall St., New York, have a contract for works here.

Hendersonville, N. C.—V. S. Hyman, Mayor, informs us that $15,000 of 6% bonds are for sale by the town. The proceeds will be used in part for the extension of the water-works.

Oxford, N. C.—Works are projected by J. W. Kittrell, Rome, N. Y.

Columbia, S. C.—The Legislature will be petitioned for authority to issue $75,000 of water-works improvement bonds.

Greenville, S. C.—The following is from J. W. Ledoux, Engineer:

The Paris Mountain Water Co. began the construction of works Nov. 1, with the American Pipe Mfg. Co., Philadelphia, as contractor and W. G. Gibbons, Greenville, sub-contractor. The supply will be by gravity from mountain springs, 7 miles distant. There will be a large storage reservoir. Wm. S. Perot, Philadelphia, is President and H. Bayard Hodge Secretary of the company. Estimated cost, $150,000. Population, 9,000.

Albany, Ga.—The following is from Nelson Tift, Water Commissioner:

A 12-in. artesian well, from which a flow of 600 galls. a minute is expected, has been contracted for. It will be completed by April 1, after which a stand-pipe 20×120 ft., one or two 1,000,000-gall. pumping engines, mains and hydrants will be wanted. The works are to be paid for from the proceeds of taxation, and therefore it may be two or three years before they are completed.

Dawson, Ga.—The following is from W. B. Cheatham, Mayor:

Last March or April a franchise was granted R. L. Bennett & Co., Tallahassee, Fla., works to be completed in 18 months. Construction has not yet been started, and unless action is soon taken the city will repeal the franchise and grant a new one, or construct the works under contract. The proposed supply is from springs by pumping to stand-pipe. Estimated cost, $50,000. Population, 3,000.

Ashville, Ala.—A franchise has been granted the Ashville Land & Investment Co.

Opelika, Ala.—Works are projected by the Opelika Water-Works Co.

East Chattanooga, Tenn.—It is reported that the East Chattanooga Land Co. has contracted for the construction of works.

Harriman, Tenn.—J. P. Suverkrop, Chief Engineer, informs us that the East Tennessee Land Co. has formulated a plan for works, but has not decided how or when it will be carried out. It is proposed to pump from the Emory River to a reservoir. A temporary supply is now in use.

North and West Knoxville, Tenn.—The Councils of both towns have postponed the granting of a franchise to either of the rival companies to some time during the first half of December.

NORTH CENTRAL.

Columbus, O.—The headings of the new lake tunnel have met and the lining is practically completed. Some time will elapse before the tunnel can be put in use, as it must first be cleared out and thoroughly washed. Further details regarding tunnel are given elsewhere in this issue.

Glendale, O.—James F. Heady informs us that if built the works will be owned by the town, and the supply taken from driven wells. Nothing further has been decided. Population, 1,750.

Brookville, Ind.—A vote in favor of works is reported.

Belvidere, Ill.—The town has voted $35,000 for works.

Du Quoin, Ill.—J. R. Truesdale, St. Louis, Mo., who is at the head of the project here, informs us that he is prospecting for a supply from wells. The contract with the city calls for 50 hydrants at an annual rental of $60 each.

La Grange, Ill.—The following is from W. S. Reed, Constructing Engineer:

The works will be put in operation about Dec. 15. They have been built by Moffett, Hodgkins & Clarke, Syracuse, N. Y. The supply is pumped from an artesian well to a 20 x 120-ft. stand-pipe. There are 6½ miles of mains.

Mattoon, Ill.—The Mattoon Clear Water Co. has filed a certificate of increase of capital stock from $100,000 to $300,000.

Hurley and Ironwood, Wis.—Works to supply these towns were started in 1887 by the Gogebic Water & Gas Supply Co. Litigation afterward arose with the Northwestern Water & Gas Supply Co., Minneapolis, Minn., and recently the latter company has operated the works, though not yet completed. It is now reported that the Ironwood Water-works Co. has been organized and will expend $150,000. It is also stated that some work will be done at Hurley.

NORTHWESTERN.

Algona, Ia.—The mains are laid and the pumps will soon be ready for use. It is reported that the well may not furnish a sufficient supply. A stand-pipe will be used.

Parkersburg, Ia.—W. H. Owen, Mayor, informs us that it is proposed to construct works next summer.

Rockford, Ia.—N. D. Bowles, Clerk, has sent the following:

The town wishes to build works as soon as possible, more especially for fire protection. Water would be taken from Shell Rock River, at an estimated cost of $8,000. Fremont Turner, Humboldt, Ia., has charge of preliminary surveys, and C. Yorker is Mayor. Population, about 1,600.

Sheldon, Ia.—C. S. McLaury informs us that works are needed, but no proposition to that end is before the town. Population, 2,000.

Sioux City, Ia.—The following is from Henry Wingeland, City Engineer:

Plans are now being made for a new supply to be obtained by pumping from the Missouri River. It is expected that it will take two years to complete the plant. The special water committee recommends that a temporary supply be obtained from driven wells similar to those at Fremont, Neb.

Later reports state that Charles H. and George E. Godfrey are looking over the ground with a view to putting in their system of wells, consisting, in this case, of about 50 driven wells connected with a large central well or reservoir.

Waverly, Ia.—Geo. M. Foster, contractor for the pipes and specials, informs us that the town works will be in operation about Jan. 1. The supply is pumped from a well and river directly to the mains. The contracts are all, or practically all, let.

Hebron, Neb.—The contract for pumping machinery has been awarded to the Buffalo (N. Y.) Steam Pump Co.

Liberty, Neb.—Works are projected.

Montgomery, Minn.—It is reported that $5,000 works are to be built.

SOUTHWESTERN.

Eagle Pass, Tex.—Fred H. Hartz, President, informs us that a 2,000,000-gall. reservoir will be built.

Gatesville, Tex.—V. A. Snow informs us that the works of the Gatesville Water Supply Co. will be in operation about Jan. 1. The supply will be from an artesian well. J. W. Sanders is Secretary. Population, 2,350.

Seymour, Tex.—L. A. Donnell informs us that the works here, mentioned last week will be owned by O. J. Gorman & Co., Houston, and will cost about $75,000, including the ice and lighting plant.

Antoinette, Col.—Small works, probably for fire protection may be built. Estimated cost, $3,000.

Coal Creek, Col.—Proposals are wanted for constructing a reservoir 50 ft. in diameter by 10 ft. deep, for 10 hydrants and one mile of 3-in. wrought iron pipe and laying and setting the same. Address the Town Clerk.

Green Mountain Falls, Col.—Works have been finished by the Ute Pass Land & Water Co.

Sterling, Col.—H. B. Davis, President of the Board of Trade, informs us that works are desired.

PACIFIC.

Forest Grove, Ore.—R. A. Habersham has completed preliminary surveys for the supply main from Gale Creek, about three miles distant.

Yuma, Ariz.—A domestic supply may be introduced by the Yuma Pumping Irrigation Co.

Mullan, Ida.—It is reported that works are being built by A. M. Strode.

CANADA.

Huntington, P. Q.—D. Boyd, Chairman of the Water Committee informs us that an investigation regarding works is being made. Nothing definite has yet been decided. River Chateaugay will be the source of supply, and direct pumping will probably be used.

Essex, Ont.—Works estimated to cost $25,000 have been projected.

ARTESIAN WELLS.

Vienna, Ga.—C. T. Small, Mayor, informs us that a well will be bored in the Court House Square.

Galveston, Tex.—The city council has contracted with J. H. Miller & Co., Chicago, for the boring of a 3,000 ft. artesian well, the price being $75,000, to be paid when the well is completed. This is to be an experimental well, and if successful enough more will be put down to furnish the city's water supply.

Southern Pacific Ry. Co.—It is reported that several wells will be sunk by this company between San Antonio and Rio Grande, Tex.

Portland, Ore.—Thomas Corbett will sink a well for the new building of the *Oregonian*.

IRRIGATION.

Colorado Springs, Col.—The Cheyenne Park, Land & Water Co. has been incorporated with a capital of $370,000.

Leadville, Col.—The Leadville Power, Water & Mining Co. has been incorporated by T. W. Owens, C. N. Perdy and others with a capital stock of $300,000. Water for mining purposes will be taken from the Iowa Ditch at Leadville.

Rio Grande, Saguache and Costilla Cos., Col.—The Mesa Land & Canal Co. has been incorporated with a capital stock of $175,000.

Clayton, N. M.—The incorporators of the Apache Valley Irrigation Co., mentioned last week, are: John C. Hill and R. P. Ervien, Colfax Co., and Charles M. Perin Trinidad, Col.

Gold Hill, Ore.—F. H. Brigham is investigating the construction of a ditch leading from Rogue Run, below this place.

Umatilla Co., Ore.—The survey of the ditch of the Umatilla Irrigating Co. has been started. It is stated about $1,000,000 will be expended if the survey gives satisfactory promise.

Yuma, Ariz.—The Yuma Pumping Irrigation Co. proposes to take water from the Colorado River, perhaps by pumping, for irrigation and domestic purposes. A canal is under construction.

Boise City, Ida.—The Boise City & Nampa Irrigation Co. has let contracts for the completion of the Ridenbaugh ditch, recently purchased. It is expected that it will be completed to Nampa by Jan. 1.

SEWERAGE AND MUNICIPAL.

Sewers.—*Nashua, N. H.*—The Artillery Pond sewer is approaching completion. It will be 5 ft. below the grade of the old sewer.

Newark, N. J.—The commissioners appointed by the Supreme Court, of New Jersey, to assess benefits for the intercepting sewer, including pumping station and wood flume to Newark Bay, constructed an order to provide an improved system of sewerage for the city, report that the whole cost should be paid by the city.

Pittsburg, Pa.—The Chief of the Department of Public Works has been directed to advertise for proposals for the construction of 20-in. pipe sewer on Black St., and a 15-in. pipe sewer on College St.

Columbus, O.—Several catch basins and sewers in the eastern part of the city are said to need repairing, but there is no money in the sewerage and drainage fund, and other means will have to be found to raise the necessary money.

Lexington, Ky.—A system of sewerage is projected, and Mr. Scowden, City Engineer of Louisville, has been asked to prepare plans and estimates.

Hendersonville, N. C.—Mr. V. S. Hyman, Mayor, informs us that a small sewerage system will be built.

Brunswick, Ga.—The West Sewerage & Sewage Utilization Co. will put in a West system of sewerage. The Lookout Sewer Pipe Co., of Chattanooga, Tenn., will furnish 17 miles of pipe.

Jacksonville, Fla.—A sewer will be built on Commercial St., with an iron outlet pipe extending into the river 25 ft. below low water.

St. Paul, Minn.—For sanitary reasons the Health Commissioner recommends that all houses should make sewer connections. There are over 18,000 sewer connections built, about 150 to the mile, but only 4,500 houses are actually connected with the sewers. A good deal of sickness has been reported from houses not having the connections.

Street Work.—*Providence, R. I.*—The commissioners have estimated the cost of a new layout of Greenwich St. at $73,320, of which the city will pay one-fourth, leaving $54,990 for the abuttors and other interested parties.

Newark, N. J.—The street work projected under the new street paving law will amount to about $1,000,000, and work amounting to about $760,000 has already been contracted for. The law, however, only authorized the issue of $600,000 in bonds, further improvements to be provided for by the assessments levied from time to time on the work done.

Allegheny, Pa.—There is said to be no money in the contingent fund to pay for the repairing of Federal St. The Controller thinks it would be better to issue bonds for street improvement than to provide the money by direct taxation.

Indianapolis, Ind.—The street and alley committee will meet Dec. 1 to consider the City Engineer's estimates for asphalt paving on Washington St., broken stone on Madison Ave, and the improvement of King St.

Columbus, O.—The City Council will issue bonds to provide for the paving and improving of Dennison Ave.

Denver, Col.—The Barber Asphalt Paving Co. has written to the Board of Public Works to protest against the way in which Fifteenth and Sixteenth Sts. are being torn up, both before and after the concrete is laid

for the purpose of laying water-pipes. The company has the contract for laying asphalt paving on these streets, and is trying to complete the work before the winter sets in.

Berkeley, Cal.—The Oakland Paving Co. has a contract for 5 miles of macadam paving.

Pittsburg, Pa.—It is proposed to extend McCandless Ave. from the river to Stanton Ave. It will be 60 ft. wide and paved with granite.

Washington, D. C.—Capt. Russell, of the District Engineers, has submitted his annual report upon streets, sewers, etc. He reports that during the year $111,467 was expended in permit work under the street department and $86,151 in compulsory permit work. He advises more improvement of the sidewalks; says that the old-fashioned bluestone curb has ceased to be used; urges the grading of alleys and the improvement of the sidewalks about reservations and public buildings.

ELECTRICAL.

Electric Light.—New plants or extensions are proposed at Washington, D. C., address F. Hufty; Port Deposit, Md., address the Electric Light Co.; Frostburg, Md., address the Gas Light Co.; Bedford City, Va., address the Bedford Electric Co.; Roanoke, Va., address the Crozier Iron Co.; Weldon, N. C.; Elberton, Ga., address Swift, Wilcox & Braswell; Orange, Tex., address the Ice, Light & Water Works Co.

Brooklyn, N. Y.—The Navy Department has advertised for proposals for putting in a complete electric light plant in the New York Navy Yard. Bids will be opened Dec. 16.

Granville, N. Y.—The town has voted to install an electric light plant.

New York City.—At a recent meeting of the Gas Commission it was decided to advertise for bids to supply 1,386 electric lights on the streets and parks, bids to be in before Dec. 4.

Washington, D. C.—The War Dep't. has advertised for bids on 4 No. 16 Edison dynamos, 2 high-speed 125-HP. engines and fittings for a complete light plant, all material to be delivered on or before Dec. 10.

Richmond, Va.—The Richmond Railway & Electric Co. have offered to furnish the city 134 lights of 1,200 c.p. at the rate of 19½ cts. a light a night. As this was the only bid received, the company will probable receive the contract.

Tampa, Fla.—The schedule of prices charged for electric light service by the Tampa Electrical Light Co. is as follows: 16-c. p. lamps, 3 cts., after 10 o'clock, ½ ct. per hour extra; 20-c. p., 4 cts., after 10 o'clock, ½ ct. extra; 32 c. p., 6 cts., after 10 o'clock, 1 ct. extra; 45 c.p., 9 cts., after 10 o'clock, 1½ cts. extra; 60 c. p., 12 cts., after 10 o'clock, 2 cts. extra; 100 c. p., 20 cts., after 10 o'clock, 3½ cts. extra.

Louisville, Ky.—The Louisville Gas Co. has been awarded the contract for 150 lights of 2,000 c. p. at $66 per light per annum.

Milwaukee, Wis.—The Edison and Badger Electric Light companies have applied to the City Council for permission to consolidate. It is stated that from $2,000,000 to $3,000,000 will be invested in the united plant, which will supply both lighting and power circuits.

Avoca, Neb.—The electric light plant which is to be erected here will probably be eventually operated in connection with the water-works.

Power Plants.—*West Asheville, N. C.*—According to an exchange, the Improvement Co. in this town will build a dam, 150 ft. long and 9 ft. high, across a neighboring stream, and use the power so obtained for driving an electric light and power plant.

Anaconda, Mont.—The plant is composed, according to a local newspaper, of three 300 HP. Leffel double discharge water wheels, connected by 18-in. belts to a 9-in. steel shaft, 84 ft. long, which are connected in turn to the 20 dynamos and 5 small exciters. Two incandescent dynamos are of 1,500 lamps capacity each, while there are 3 smaller machines for the same service of 500 lamps each. There will be a number of 60 arc light Westinghouse machines and 20-light United States dynamos.

Baxter Electric Car Motor.—The Baxter Electric Motor Co. is reported as constructing an experimental track, an eighth of a mile long, on which to experiment with a combination car, propelled by either storage batteries or an overhead trolly system. The company's motor is provided with gears running in oil boxes in order to deaden the noise.

New Companies.—Suburban Electric Co., Montreal, P. Q.; capital stock, $25,000; incorporators, H. Joseph, R. D. McGibbon, C. Cassils. Roberts Storage Battery Co., Portland, Me.; capital stock, $1,500,000; J. W. Symonds, Treas. Henderson, Ky., Electric Light & Power Co.; capital stock, $50,000. Greenville, Ill., Electric Light & Power Co., capital stock, $10,000; incorporators, C. D. Holles, W. V. Weise, V. Harrold. Mutual Gas & Electric Light Co., San Francisco, Cal.; capital stock, $3,000,000; incorporators, I. W. Knox, E. Bosqui, M. Classen, J. W. Burling and J. T. Rowand.

CONTRACTING.

Granite.—*New York City.*—The Department of Docks has awarded a contract to Wm. J. Clark as follows: 95 cts. per cu. ft. for header and stretcher stones for bulkhead wall; $1.13 per cu. ft. for coping stones; $70 per 1,000 for granite paving blocks. The contract will amount to about $23,000.

Pipe.—*Chicago, Ill.*—The following proposals have been received for 6, 8 and 12-in. cast-iron pipe: McNeal Pipe & Foundry Co., Burlington, N. J., $29.70 for 6 and 8-in., $29.25 for 12-in.; Gloucester Iron Works, Philadelphia, Pa., $29.45 for 6 and 8-in., $26.90 for 12-in.; Addyston Pipe & Steel Co., Addyston, O., $26.29 per ton of 2,000 lbs.; R. D. Wood & Co., Philadelphia, Pa., $27.40; Shickle, Harrison & Howard Mfg. Co., St. Louis, Mo., $26.45; Dennis Long & Co., Louisville, Ky., $26; Lake Shore Foundry, Cleveland, O., $26.75; Buffalo Iron & Pipe Co., $27.

City Work.—*Brooklyn, N. Y.*—Proposals have been received by the Dept. of City Works for a sewer in Richard St.: Harris & Maguire, $5.84 per ft. for 36-in. brick sewer, $35 each for manholes, $100 each for basins. Peter Milne, $4.50, $30, $100. Edward Gorman, $3.95, $25, $97.

Omaha, Neb.—The Board of Public Works has awarded a contract for grading Tenth St. to M. Van Camp, at 12 cts. per cu. yd.; and to C. F. Haman for resetting curb on St. Mary's Ave., at 25 cts. per ft.

Los Angeles, Cal.—A contract has been awarded to the Asphalt Paving Co., at 11.9 cts. per sq. ft., for asphalt walks.

Sewer Blocks.—*Baltimore, Md.*—The following proposals have been received for stone blocks for the Cross St. sewer: McClenahan Bros., $105 per 1,000, $2.94 per sq. yd.; Guilford & Watersville Granite Co., $2.80; Wm. F. Weller, $3.09; Gill & Johnson, $2.63; B. Kepner, $2.10, and $100 per 1,000 blocks.

PROPOSALS OPEN.

Street Work.—*Newark, N. J.*—Granite, trap and Belgian block paving on several streets. John Hunkele. Street Commissioner. Nov. 26.

New York City.—Asphalt paving on concrete and on present stone blocks; granite block paving on concrete. Department of Public Works, 31 Chambers St. Dec. 1.

Providence, R. I.—Straight and circular curbing, crosswalk stone; 5,000 sq. yds. granite blocks. J. A. Coleman, Commissioner of Public Works. Dec. 3.

Bonds.—*Cincinnati, O.*—Liberty St. bridge bonds, $68,000. Edwin Stevens, Comptroller. Dec. 10.

Dayton, O.—Sewer bonds, $50,000. C. A. Herbig, City Auditor. Nov. 24.

Sewer.—*Poughkeepsie, N. Y.*—Vitrified pipe, 2,200 ft. of 24-in.; manholes and basins. Chas. E. Fowler, Supt. of Sewers. Nov. 28.

Road.—*Marietta, Ga.*—Macadam road to national cemetery. Major J. W. Scully, U. S. Engineer Office Atlanta, Ga. Nov. 27.

Street Lighting.—*Jersey City, N. J.*—For one year. G. P. Robinson, Clerk of Board of Police Commissioners. Dec. 1.

Building.—*Bay City, Mich.*—Excavation, concrete foundation, stone and brick work; iron beams, girders and columns for U. S. building. Jas. H. Windrim, Supervising Architect, U. S. Treasury Dept., Washington, D. C. Dec. 4.

City Work.—*Buffalo, N. Y.*—Barber asphalt pavement, German Rock Asphalt Co.'s pavement, sewer of 30-in. iron pipe, and 72 and 60-in. brick; 10-in. tile sewers. Geo. E. Mann, City Engineer. Nov. 24.

New York City.—Regulating, grading, curbing, flagging, crosswalks and culverts; granite block paving, sewers. Department of Public Parks, 49-51 Chambers St, Nov. 26.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive works, of Schenectady, N. Y., have an order for 25 ten-wheel passenger, 30 ten-wheel freight and 10 six-wheel switch engines for the Chicago & Northwestern Ry. They have delivered 6 eight-wheel engines, with cylinders 18×24 ins., for the Cincinnati, Hamilton & Dayton. The Baldwin Locomotive Works, of Philadelphia, Pa., have an order for 50 locomotives for the Pacific Coast extension of the Great Northern Ry. Also for 2 consolidation engines, with cylinders 20×24 ins. for the Cincinnati, Hamilton & Dayton. The Brooks Locomotive works, of Dunkirk, N. Y., have built 3 ten-wheel engines for the Lake Shore & Michigan Southern Ry. The Manchester Locomotive Works, of Manchester, N. H., are building a ten-wheel engine for the New York, Providence & Boston R. R. The Rogers Locomotive works, of Paterson, N. J., have orders for Class H mogul engines for the Chicago, Burlington & Quincy. The Lima Machine Co., of Lima, O., has delivered an engine to the Montana Union Ry. Dubs & Co., of Glasgow (Scotland), have an order for 3 Fairlie engines for the mountain division of the Mexican Ry.

Compound Locomotives.—The Rhode Island Locomotive Works, of Providence, R. I., have compounded one of the tank engines of the Union Elevated Ry., of Brooklyn, N. Y. The cylinders were 11×16 ins., and are now 11½×16 ins., and 18×16 ins. Live steam is used in both cylinders at starting, and may also, under exceptional circumstances, be used while running. They are building a compound eight-wheel fast passenger engine for the Macon Construction Co., of Macon, Ga. Dubs & Co., of Glasgow (Scotland) are building 4 compound engines for the City of Mexico and Esperanza division of the Mexican Ry.

Locomotive and Car Works.—The Grant Locomotive Co. has finally secured possession of the site for its new works in Chicago, and work will shortly be commenced. Mr. E. T. Jeffery and Mr. George M. Bogue, of Chicago, are at the head of the enterprise. The Beaumont Car Co. has been organized by Boston (Mass.) and local capitalists to establish car works at Beaumont, Tex.; capital stock, $500,000. It is reported that the Corey Car Works, of Chicago, will establish a plant at Waukegan, Ill.

Cars.—The Mt. Vernon Car Co. is building 500 cars for the Jacksonville Southeastern Ry. The Harrisburg Car Co. is building 150 tank cars for the Standard Oil Co. The Lehigh Valley R. R., New York, Lake Erie & Western R. R., and Missouri, Kansas & Texas Ry. are in the market for new rolling stock. The Barney & Smith Mfg. Co., of Dayton, O., has delivered 25 passenger cars to the Pennsylvania R. R.

Spikes.—Dilworth, Porter & Co., of Pittsburg, Pa., are now manufacturing the Goldie and ordinary spikes of Bessemer steel as well as iron.

Steel Cross Ties.—The Schofield Metal Cross Tie Co., of Chattanooga, Tenn., which owns the patents on the Schofield tie, proposes to build a rolling mill for the manufacture of these ties.

Steam Road Roller.—Aveling & Porter steam rollers (W. C. Oastler, of New York, agent,) have recently been purchased for Shelburne, Vt.; Utica, N. Y.; Flushing, L. I., and Key West, Fla.

Steel Works.—Carnegie, Bros. & Co., of Pittsburg, Pa., have purchased the Allegheny Bessemer Steel Works. The Westerman Natural Gas Iron Co. has been organized at Marion, Ind., to establish steel rail mills; capital stock, $100,000; incorporators, Geo. L. Masno, James Westerman, George Westerman, W. H. Wiley.

New Companies.—Prescott Equipment Co., of Chicago, Ill.; to manufacture railway supplies; incorporators, J. W. Taylor, Chas. Eldred and M. Lapham. Baltimore Tin Plate Co., of Chicago; capital stock, $200,000; incorporators, Max Vam, Hy. H. Kennedy and Geo. Einstein. American Light & Fuel Co., Jersey City, N. J.; capital stock, $500,000; to construct gas plants for heat, light and power. South Zanesville Sewer Pipe Co., of South Zanesville, O.; capital stock, $25,000. Moomow Automatic Car Coupler Co., of Pensacola, Fla.; capital stock, $50,000; to manufacture a coupler invented by H. E. Moomow, of Caryville, Fla. Cooke Safety Switch & Railway Improvement Co., of East St. Louis, Ill.; capital stock, $100,000; incorporators, E. J. Crandall, W. L. Parkhurst, G. C. Whitney; to manufacture a safety switch. Canton Malleable Iron & Mfg. Co., of Canton, O.; capital stock, $100,000. Michigan Car Co., of Detroit, Mich.; capital stock, $500,000. Styron National Fuel Gas Co., of Newark, N. J.; capital stock, $200,000; incorporators, John L. Styron, of Newark, and W. C. Reddy, of New York City. Standard Fireless Engine Co., of Chicago, Ill.; to apply ammoniacal gas, etc., for locomotive and other engines; capital stock, $1,500,000; incorporators, P. J. McMahon, John Woltz and E. V. Hitch. Buffalo Cast Iron Pipe Co., of Buffalo, N. Y.; incorporation extended for 10 years; capital stock, $40,000; incorporators, Geo. W. Miller, Jonathan Scoville, N. C. Scoville and Geo. B. Hayes.

Pumps.—The Valley Pump Co., of Easthampton, Mass., is furnishing pumps to the Great Northern Ry., for use on the Pacific coast extension.

Metal Market Prices.—*Rails*—New York: $28.50 to $29; old rails $24.50 to $25 for iron and $20 to $21 for steel. Chicago: $31 to $31.50; old rails, $25.50 to $26 for iron and $16.50 to $20 for steel. Pittsburg: $29 to $29.50; old rails, $28 to $28.50 for iron, and $18 to $19 for steel.

Foundry Pig-iron.—New York: $16.50 to $18. Chicago: $15 to $17. Pittsburg: $15.50 to $17.50.

Track Materials.—New York: steel angle bars, $1.70 to $1.80; spikes, $2 to $2.15; track bolts, 2.75 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron, 2 to 2 1 cts. for steel; spikes, 2.2 cts.; track bolts, 2.9 with square, and 3 cts. with hexagon nuts. Chicago: splice bars 2.10 for iron and 2.15 to 2.20 for steel; spikes 2.3 to 2.35 cts.; track bolts 3.10 cts. with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—Chicago, 5 to 5.15 cts. New York, 4.80 to 4.85 cts.

Structural Material.—Pittsburg: angles, 2.3 cts.; tees 2.85 cts.; beams and channels, 3.1 cts.; sheared steel bridge plates, 2.65 to 2.7 cts.; universal mill plates, iron, 2.3 cts.; refined bars, 1.9 to 2 cts.; steel plates, 4 to 4.50 cts. for fire box; 3 cts. for flange; 2.8 cts. for shell, 2.4 cts. for tank. New York: beams, 3.10 cts.; plates, 2.25 cts.; angles 2.1 to 2.25 cts.; tees, 2.6 to 2.7 cts.; channels, 3 cts. Chicago: angles, 2.35 to 2.4 cts.; tees, 2.9 to 3.0 cts.; beams, 3.2 cts.; universal plates, 2.45 to 2.5 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel

Proposals for Bonds.

The City of Hallettsville, Lavaca county, Tex., will receive bids for $16,500 6% 50-year bonds, with privilege of redeeming at the expiration of 25 years, up to Dec. 1, 1890. Further information can be obtained by corresponding with WM. BLAKESLEE, City Clerk.

JESSE GREEN, Mayor. 47-3t

Notice to Contractors.

"Sealed proposals will be received by the Port Reading Construction Company, at the office of their Chief Engineer, 227 South 4th St., Philadelphia, up to and including Dec. 8, 1890, for the construction of the line of the Port Reading Railroad, beginning at a point about 970 feet southeast of the Lehigh Valley Railroad crossing of the Delaware & Bound Brook Branch of the Philadelphia & Reading Railroad, in Somerset County, New Jersey, to a point on the Arthur Kill in Middlesex County, same State, known as Port Reading.

"Plans, profiles and specifications can be seen at the above office, where all information desired can be obtained.

"The Company reserves the right to reject any and all bids, or any portion thereof."

47-1t.

Toronto Water-Works.

PROPOSALS FOR PUMPING MACHINERY AND BOILERS.

Sealed proposals will be received by the Trustees of Water-Works of the City of Toronto, Jefferson Co., Ohio, at their office in said city, until 12 o'clock noon, of Wednesday, Dec. 3, 1890, for furnishing vertical pumping machinery having capacity to pump 3,000,000 U. S. galls. of water per 24 hours, from the Ohio River, the source of supply, to the Walker Hill Reservoir—some 3,000 ft. distant, and with an altitude of approximately 325 ft. above low water in said river.

Bids will be received for one pumping engine of above capacity, and also for two pumping engines each with capacity to pump 1,500,000 galls. per 24 hours—the trustees reserving the right to accept either after receiving bids for same.

Also for two return tubular boilers, each 5 ft. diameter and 14 ft. long.

Bids will be understood to include all foundations and the placing of the machinery thereon, unless otherwise expressly stipulated in bid—including all piping, both for steam and water—inside the building. Also including all boiler foundations, settings and fixtures complete.

General specifications, forms of proposal and forms of contract will be furnished from and after Nov. 15, 1890.

The right to reject any or all bids is hereby reserved.

O. Y. CRAWFORD,
Trustee and Secretary.

J. D. COOK, Toledo, O., Consulting Engineer,
TORONTO, O., Oct. 26, 1890. 47-1t

PROPOSALS FOR EXTENSION OF PIERS and repairs, U. S. Engineer Office, Cleveland, O., Nov. 15, 1890. Sealed proposals, in duplicate, will be received at this office until 12 o'clock M., Saturday, the 6th day of December next, at which time they will be opened in presence of bidders, for extending pier and making general repairs to piers at the following harbors on Lake Erie: Ashtabula harbor, O.; Fairport harbor, O.; Black River harbor, O.; Huron Harbor, O. Preference will be given to materials and plant of domestic production or manufacture, conditions of quality and price (import duties included) being equal. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 332, and vol. 24, p. 414, Statutes at Large. All information can be obtained at this office. The United States reserves the right to reject any or all proposals. L. COOPER OVERMAN, Major of Engineers. 47-2t

Notice to Contractors.

Sealed proposals will be received at the office of the Water Board of the city of Poughkeepsie, N. Y., until noon of Friday, Nov. 28, 1890, for furnishing and laying about 2,200 ft. of 24-in. vitrified sewer pipe, with manholes and silt basins. Plans may be seen, and specifications and forms of proposal obtained, at the said office.

All proposals must be made upon the forms aforesaid, and must comply with the terms of the notice prefixed thereto. The right is reserved to reject any or all proposals.

By order of the Water Board.

CHAS. E. FOWLER,
46-2t Superintendent.

S. E. NOBLE, Prest. JNO. E. WARE, Secy. and Treas. R. F. CARTER, Supt.

The Anniston Pipe Works,

MANUFACTURERS OF

CAST IRON WATER AND GAS PIPE,

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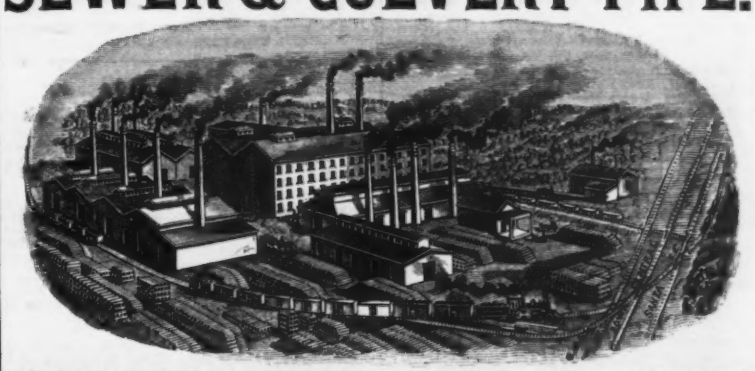

MONMOUTH MINING & MFG. CO., MONMOUTH, ILL.

U. S. ENGINEER OFFICE, WILMINGTON, N. C., Nov. 6, 1890.—Sealed proposals for sheet piling, stone, mattresses, etc., in place in dike in Winyaw Bay, S. C., are to be received at this office until 12 M., Dec. 15, 1890. The attention of bidders is specially invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 332, and vol. 24, p. 414, Statutes at Large. All information furnished by W. H. BIXBY, Capt. of Engineers. 46-4t

BREAKWATER AT PORTCHESTER Harbor, N. Y., and at Larchmont Harbor, N. Y. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov. 15, 1890. Sealed proposals in triplicate for construction of breakwaters at Portchester Harbor, N. Y., and at Larchmont Harbor, N. Y., will be received at this office until twelve (12) o'clock noon on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

EXTENSION OF BREAKWATER AT Glen Cove, N. Y. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov. 15, 1890. Sealed proposals in triplicate for extension of the breakwater at Glen Cove, N. Y., will be received at this office until twelve (12) o'clock noon on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for Specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

U. S. ENGINEER OFFICE, BURLINGTON, Vt., Nov. 13, 1890. Sealed proposals, in duplicate, addressed to the undersigned, will be received at this office until 11:30 o'clock A. M., Dec. 15, 1890, and then publicly opened, for furnishing 1,610 cu. yds. of rubble stone, 1,783 cu. yds. of large stone (one to three tons weight) and completing the continuation of 135 lin. ft. of extension to the breakwater at Gordon's Landing, Lake Champlain, Vt. Attention is invited to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Detailed information can be had on application. M. B. ADAMS, Major of Engineers. 46-3t—49-1t

PROPOSALS FOR CONSTRUCTION OF breakwater at Rockland, Me. U. S. Engineer Office, Portland, Me., Nov. 11, 1890. Sealed proposals in triplicate for construction of breakwater at Rockland, Me., will be received at this office, No. 537 Congress St., until 3 P. M. of Tuesday, December 2, 1890, and then opened. Attention is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, p. 332, and Vol. 24, p. 414, Statutes at Large. All necessary information furnished by JARED A. SMITH, Lieut.-Col., Corps of Engineers, U. S. Army. 46-3t

U. S. ENGINEER OFFICE, WILMINGTON, N. C., Nov. 6, 1890.—Sealed proposals for dredging in the Cape Fear River at and below Wilmington, N. C., and Lockwood's Folly River, N. C., will be received at this office until 11 A. M., Dec. 15, 1890. The attention of bidders is specially invited to Acts of Congress, approved Feb. 26, 1885, and Feb. 23, 1887, vol. 23, p. 332, and vol. 24, p. 414, Statutes at Large. All information furnished by W. H. BIXBY, Capt. of Engineers. 46-4t

EXTENSION OF BREAKWATER AT mouth of the Housatonic River, Connecticut. Engineer Office U. S. Army, Room 74, Army Building, 39 Whitehall street, New York, N. Y., Nov. 15, 1890. Sealed proposals, in triplicate, for extension of the breakwater at the mouth of the Housatonic River, Connecticut, will be received at this office until twelve (12) o'clock noon, on Monday, Dec. 15, 1890. The attention of bidders is invited to acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Further information can be obtained at this office. Applications should be indorsed on envelope "Applications for Specifications." D. C. HOUSTON, Colonel of Engineers. 46-4t

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U. S. ENGINEER OFFICE, CHARLESton-Kanawha, W. Va., Nov. 3, 1890. Proposals for building the foundations and the pier, abutment, etc., for a movable dam at lock No. 8 of the Great Kanawha River Improvement, will be received at this office until 3 P. M. of Dec. 19, 1890, and then opened. The attention of bidders is called to the Acts of Congress approved Feb. 26, 1885, and Feb. 23, 1887, Vol. 23, page 332, and Vol. 24, page 414, Statutes at Large. Information can be obtained by application to Addison M. Scott, Resident Engineer. WM. P. CRAIGHILL, Colonel of Engineers, U. S. A. 46-4t.

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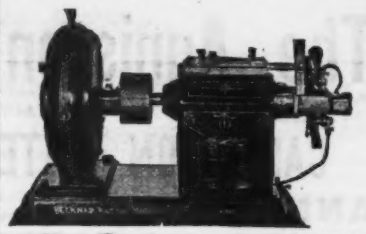

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